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GAS FIRE GUARDS

THE campaign to diminish, and if possible eliminate, burning and scalding accidents in the homes of Britain has taken some time to achieve results. Not a long time as medical crusades go, it is true, but a surprisingly long time in a period such as now obtains, when our medical welfare is zealously guarded and dangers to life and limb serve to bleed our national exchequer beyond even its present anæmic limits. However, the efforts of Dr. Leonard Colebrook, former Director of the Medical Research Burns Unit at Birmingham, and his wife, have at last borne fruit. A Bill to prohibit the sale of some heating appliances without an effective fireguard, introduced by Mr. Bullard, Conservative M.P. for South-West Norfolk, is down for a second reading in the Commons in the next session. Before the matter reaches the political column, we might do well to recall some of the factors leading up to this new awareness that all is not as it might be in our claim to provide a service with the maximum safety as well as efficiency.

It was an article by the Colebrooks and published in the *Lancet* in mid-1949 which first brought a certain disquiet to those concerned with the manufacture and sale of heating appliances. That report was the subject of an article which appeared in the September issue of *Gas Service* for that year, under the title ' Are Gas Fires Safe? ' At that stage the Colebrooks were content with pointing a warning finger at the alarming figures compiled during the course of their work. The report investigated the causes of 1,000 burning and scalding accidents whose victims passed through the Colebrooks' hands. A second year's figures were added to the first, producing the following results: One-third of the total admissions to the hospital were industrial accidents. Of the home accidents 54% happened to children under five, and 71% to children under 15. Roughly half of the total accidents was the result of the victim coming into contact with a domestic heating appliance. In 236 instances an open coal fire was involved, in 121 cases an electric or gas fire. In 208 of the 236 accidents associated with coal fires and in 118 of the 121 accidents due to electric or gas fires, no fireguard was in use. In most of the remaining 31 cases, the guard was unattached and was removed by the child. No less than 60 of the 75 deaths resulting from burning accidents were caused by contact with a fire, and in 48 of the 62 fatal cases whose clothing had ignited this was the result of contact with a fire; 169 of all the 263 clothes-caught-fire cases were due to such a contact.

It might be argued—in fact, has been argued—that the number of cases under review is not high. By national standards that is quite true; but is a total of 2,000 cases too small to be used as a basis for calculating national figures? We do not think so. We see no reason to suppose that the proportion of cases caused by inadequately guarded fires, and dealt with by this Birmingham hospital, is larger than the proportion of similarly caused cases elsewhere. Indeed, it is estimated that in England and Wales about 1,000 accidents (120-150 of them fatal) are likely to be caused by gas and electric fires in the space of a year. Looked at in this light the problem assumes a new seriousness and a new urgency. With the record of coal and electric fires we are only indirectly concerned. The important point is that the gas industry itself is by no means free from blame. How best to remedy the situation?

A CHALLENGE

IN no small measure the Colebrooks have provided the answer. Not content with collecting and analysing this somewhat damning evidence, in their latest report, published in the September 29, 1951, issue of the *Lancet*, they have put forward a series of practical suggestions for reducing accidents of this nature, based on energetic enquiry and an understanding of publicity rare among the medical profession. Their work and views have been widely publicised in the popular Press (a comprehensive article by Dr. Colebrook appeared in *The Times* as recently as last Monday) and

by the B.B.C., and the thinking public expects to see their suggestions in concrete form. The more so as the problem has already been solved in most countries abroad.

The whole background of the problem was described in an article in the December issue of *Gas Service*, under the title 'The Case for Gas Fire Guards.' In this article the Colebrook report was examined critically and a special section dealt with the steps being taken by manufacturers to meet the situation. At the moment, however, we will content ourselves with underlining some of the salient points of that article, indicating in broad outline the progress made to date.

The main outcome of the Colebrooks' suggestions was the publication of amendments to the British Standards covering the design and manufacture of electric and gas fires. The latter—Amendment No. 1 to B.S. 1250—states that portable and panel gas fires should conform to what has become known as the cone test, which governs the mesh of the guard, and certain other tests concerning the catching alight of a piece of material of prescribed size; the amendment also states that hearth type fires should have provision for the fitting of a guard and a suitable guard should be available.

The reaction of our manufacturers to this specification has been excellent, but they are seriously hampered by lack of material, purchase tax, and other troubles. In our view these regulations can only be put into proper effect by constructive co-operation at three levels: It is the Government's responsibility to ensure that priority is given to supplies of material to be used for such safety measures, and remove any tax restrictions on the provision of guards; it is the area boards' responsibility to supply fires which are adequately guarded and to draw consumers' attention to their advantages; and it is the responsibility of every body concerned with the good name and reputation of the industry and also the welfare of the public to focus interest on the importance of adequate safety measures. The Gas Council must play its part and so must the Women's Gas Federation; home service staff must be briefed on how best to stress the advantages of properly guarded appliances.

The point we wish to make is this: That by drawing attention to a serious danger in the use of gas fires we are not cutting our own throats. On the contrary, what finer selling theme can there be than the essential safety of gas appliances equipped with neat, unobtrusive, but entirely efficient guards? There has already been considerable publicity on this matter; there will be a great deal more. It is therefore not unreasonable to suppose that the industry which is quickest off the mark with its theme of safety and service will reap a rich reward.

THE BUILDING CENTRE

SINCE its inauguration in 1931 the Building Centre has never lacked publicity in our columns. We have followed its progress from New Bond Street and the Grafton Galleries to Conduit Street, where it moved in 1942, with keen interest. We were among the first in the gas industry to appreciate just how important was this shop window *par excellence* to our future prosperity. Now we have the pleasant task of recording another milestone and another move—this time to Store Street, W.C.1, where the new Centre was opened to the Press last week.

It is no exaggeration to suggest that this is the Centre's most significant step to date. Not only is the new building several times larger than the old; it boasts an impressive exterior, an abundance of daylight, and the exhibition is spread over all four floors and basement. In the allocation of space to the various industries represented, the gas industry has been singularly fortunate. Its new section is three times its former size and occupies a position adjacent to but probably better than its electrical counterpart. Most gratifying, however, is the fact that when the Centre first opened in its new premises on December 3 no time was lost in installing an excellent temporary display of gas appliances. At a time when much of the building was in a state of chaos the gas section was functioning very much in its usual smooth way—greatly to the credit of those concerned.

However, the new Centre's finest gas publicity is to be found not in the first floor gas section but in the bowels of the building. The central heating installation, consisting of gas-fired boilers serving a radiator system, has wisely been utilised as an exhibit in itself. The model boiler house for which a special system of controls has been devised is one of the building's principal attractions, and is described and illustrated elsewhere in this issue.

We now look forward to seeing the Building Centre's activities and influence widen in proportion to its enlarged facilities—facilities which include a lecture room and hall for temporary exhibitions. We look forward also to the new gas section now in course of preparation. We have seen it in diagram and model form and gained the impression that while its general design owes much to the Conduit Street exhibition, this new section will have a scope and spaciousness unavoidably denied its predecessor.

CALENDAR AND DIRECTORY

JOURNAL subscribers and *Calendar* advertisers who have not already received their copies of the 1952 edition of the *Gas Journal Calendar and Directory* will be getting them within the next few days. We take pride in the fact that the directory information was accurate and up to date at the time of going to press, but change is paradoxically the only constant feature of such a book of reference and already we are noting appointments, retirements, and transfers which have occurred since press day. We have to acknowledge once again the help we have received from gas officials at all levels in response to our questionnaires, more particularly perhaps in these days when form-filling is too frequent a duty. Without such co-operation the preparation of a directory on which so many people who serve the industry in varied ways can rely would be impossible. With the passing years and the tendency towards integration and the closing down of the smaller works it is becoming less practicable to record the annual make or sales of individual undertakings, but

where such information has been obtainable it has been included, and overall figures give a general picture of the upward trend, while the statistical summary in the handbook section gives area totals for 1950, together with those for 1949 for comparison.

The trade section—displayed advertisements, advertisers' directory, and buyers' guide—reflects the enterprise of gasworks contractors and makers of works equipment, industrial, commercial, and domestic appliances, despite the difficulties and shortages of the times. The buyers' guide is as valuable to the gas officer as the directory of undertakings and list of personnel are to all those who have services to offer or goods to sell in the industry; both cover an ever-widening field. Starting with the *Journal* of February 6 we shall be publishing our monthly list of revisions. Meanwhile, we would bespeak the co-operation of all who use the directory (a) by using the latest edition and scrapping earlier issues; (b) by keeping us promptly informed of changes and appointments; and (c) by keeping their own copies up to date by marking up the changes as and when they are announced in the first issue of the *Journal* in each month.

CHRISTMAS POSTAL DELAYS

POSTMAN'S Knock during the Christmas festivities must have sounded somewhat hollow to those who had suffered inconvenience due to postal delays in the preceding week. The load on the Post Office is, of course, very much a peak at the period, but the 1½d.'s seemed to enjoy a preference over more vital correspondence. A matter of organisation ? What would be the feeling if, following report of a Yuletide gas escape, the emergency squad turned up to deal with the matter several days late ?

AREA BOARD MEMBERSHIP

THE Minister of Fuel and Power was empowered in 1948 to appoint the Chairman and Deputy Chairman of the Gas Council and all the members of the area boards 'for such term not exceeding five years as may be determined by the Minister before the appointment of such member, and upon such conditions as may be determined by the Minister, with the approval of the Treasury.' Appointments were in fact made for a full term of five years—until April 30, 1954, notwithstanding the fact that some of them were appointed several months before vesting date—in the case of the Chairman and Deputy Chairman of the Gas Council and the chairmen, deputy chairmen, and all full-time members of area boards, while part-time members were appointed for a uniform period of three years. Of the part-time members, 47 will therefore retire on April 30 this year, and 11 of the 12 chairmen of consultative councils, whose appointments were slightly delayed, will retire 11 days later. All members are, however, eligible for re-appointment, and we have heard no rumours of any notable changes.

A White Paper published on December 31—*Public Boards, List of Members* (Cmd. 8433)—indicated that the chairmen of the consultative councils receive a salary of £750 per annum, and the other part-time members receive £500. The salaries and allowances of the whole of the Gas Council and area boards—the present-day counterpart to the total directors' fees of pre-nationalisation days plus any allowances that may have been payable to members of municipal gas committees—amount to £175,000 per annum. The Chairman of the Gas Council receives £6,000 per annum, plus £1,000 allowances ; the Deputy Chairman £5,000 plus £500 allowances ; the chairman of each area board £4,500 plus £500 ; the deputy chairman of each board £3,500 plus £400 ; and full-time members £3,000; in addition to which there is a further allowance not exceeding £600 available at the discretion of the chairman of each area board for the use of members and part-time members. A footnote mentions that four members continue to receive the higher salaries they were paid as officers of gas undertakings absorbed under the Gas Act. Compared with other nationalised industries the salaries paid to the heads of the gas industry are on the modest side.

The White Paper includes a list of those members of public boards holding more than one appointment. Sir John Stephenson, Chairman of the Eastern Gas Board, is also an unpaid member of the British Overseas Airways Corporation ; Sir John Green, unpaid part-time member of the East Midlands Gas Board, draws £5,000 a year as Deputy Chairman of the Iron and Steel Corporation ; and Mr. A. R. McBain, part-time member of the Southern Gas Board, is also a part-time member of the Iron and Steel Corporation, and draws a basic £500 per annum in respect of each appointment.

SCHOOLBOYS' DELIGHT

IN our review of the Schoolboys' Exhibition last year, we stressed the importance of this show as a long-term policy, and emphasised the need for meeting and moulding our future consumers and workers. We do not want to go into all that again. Suffice it to say that we still hold those views and that we plunged into the asphalt jungle of the Horticultural Hall this year full of hope that our 1951 criticisms would have borne fruit. We need not have worried. So popular was the gas stand (under Gas Council patronage this time) that it took some time to get near it. While the E.D.A., which outshone the gas stand last year, has rested on its laurels and served up the mixture as before, gas has clearly learnt from its mistakes and has provided not only a more entertaining exhibit, but a much more instructive one. Its principal virtue is that it has several sources of interest. Probably the biggest attractions are the demonstrations of pottery making and glass blowing, the former using a gas-fired kiln. Running them a close second is the cartoon film 'And Now Today,' which is given regular performances ,and the usual careers section showing openings available to young people under apprenticeship schemes does not lack for an audience when the Watson House trainees do their stuff. Other items include a demonstration of the testing of the constituents of flue gases by means of a soap film analysis, and two models, one of the M.V. *Sydenham* and the other of an infra-red drying tunnel. Thus there is a variety of interest, and we noted how the attention of the bulk of the audience swung from one thing to another. The stand design is particularly good, and we were struck with the resolute behaviour of its attendants in the face of an overwhelming risk of being trampled underfoot. What criticisms we have are not of the gas stand but of the exhibition as a whole. It is divided between two halls, both extremely ugly and inconvenient, and—worst of all—devoid of litter receptacles. Perhaps next year it could be held in a better hall, suitably reinforced to withstand the onslaught of its youthful visitors. Whatever changes are made the gas stand should stick to its 1952 recipe.

Gas Service Pocket Book, 1952

The demand for copies of the 1952 Edition has constituted an all-time record, and we now have to advise our readers that the book is out ofprint.

Personal

Mr. J. C. Irminger, B.SC., has retired from his position as Chief Engineer and General Manager to the Bergen (Norway) Corporation Gasworks, a position which he had held for 32 years. He is succeeded by **Mr. Bjern Paulson.**

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Mr. Robin Wilson, Leeds, has joined G. L. Howarth & Co., Ltd., Burnley, makers of 'Rapid' washing machines, etc., and now represents them in the areas of the North Eastern Gas Board and the Northern Gas Board, exclusive of Newcastle division.

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Mr. Quertier Le Pelley, Chairman of the Guernsey Gas Light Company and Lieutenant-Bailiff of Guernsey, was created an O.B.E. in the New Year Honours in recognition of public services in Guernsey. In addition to the seven British Empire Medallists named last week the B.E.M. was awarded to **Mr. W. Trafford,** Foreman Main and Service Layer, South Bank unit of the Middlesbrough Division, Northern Gas Board.

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Mr. Ivor Preece has been selected to captain the Midland Counties v. the South African Touring Side on January 16 at Coventry. The gas industry is well represented in Warwickshire Rugby football. Mr. J. L. Anstey has succeeded to the Presidency of the Warwickshire Rugby Union, Mr. W. D. Wilson, Managing Director of George Wilson Gas Meters Ltd., is Vice-President and Mr. Ivor Preece, also of George Wilson Gas Meters Ltd., is the captain of the County XV, and of the Coventry Club.

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Mr. D. S. Woodley, A.M.I.MECH.E., M.I.H.V.E., has been appointed by the Board of Keith Blackman, Ltd., to act as Joint Managing Director with Mr. Montague Burningham as from January 1. Mr. Woodley joined the Company in 1916 and in 1925 was placed in charge of the Leeds branch office. Returning to head office in 1931, he was appointed Chief Engineer, and in 1938 elected to a seat on the Board. In 1950 he was appointed Deputy Chairman. Consequent on this new appointment **Mr. S. E. Nelson,** B.A.CANTAB., will succeed Mr. Woodley as Chief Engineer of the Company.

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Mr. J. K. Ingram and **Mr. W. J. Chadder** have been appointed Directors of the Woodall-Duckham Vertical Retort and Oven Construction Company (1920) Ltd. Mr. Ingram joined the Company in 1912 and has for 25 years been in charge of the estimating department as well as being responsible for the forward planning and negotiations for the repairs of the plants built by the Company. Mr. Chadder joined the Company in 1919 and has throughout been engaged in project and design work in connection with coke ovens and by-products recovery and treatment plants. After a period as deputy Mr. Chadder was appointed head of the coke oven sales department in January, 1949, a position which he retains.

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Mr. J. Hibbs, for 12 years Assistant Works Engineer at the Cheltenham gasworks, is retiring and will take up residence at Cleveleys, Blackpool. Before going to Cheltenham Mr. Hibbs was Assistant Engineer and Manager at the Mossley and Saddleworth and Ashton undertakings which were subsidiaries of the Severn Valley Gas Corporation. In 1934 Mr. Hibbs was awarded the Society of British Gas Industries silver medal for a paper on the design, construction, and working of a new gasworks. He has been a Vice-President of the Cheltenham Association of Engineers, a member of the Western Junior Gas Association, and for a number of years he was Chairman of the Cheltenham gasworks sports committee.

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Mr. Edward W. Taylor has left G. A. Harvey & Co. (London) Ltd., after 57 years' service, having joined the company at the age of 13½ years in September, 1894. This length of service, as was pointed out by Mr. H. T. Eatwell (Managing Director) at a presentation on December 17, constitutes a record for employees of the firm. Mr. P. Bliss (Sales Manager), in making the presentation on behalf of the staff, said Mr. Taylor began as an office boy in the accounts department at 5s. per week. His ability was recognised, and prior to his transfer to the sales staff in 1940, he was senior assistant in the accounts department. After a few years he took charge of the accounts department, where he stayed until 1920. After a further 17 years on the road he returned to head office at the commencement of the last war.

Dame Vera Laughton Mathews, D.B.E., adviser on women's affairs to the Gas Council and a Member of the South Eastern Gas Board, has recently undergone a serious operation in the Gordon Hospital, S.W.1. She is reported to be making good progress.

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Mr. R. C. Taylor, M.B.E., B.SC., M.I.MECH.E., M.INST.GAS E., General Manager of the Southern Division of the South Western Gas Board, retired on December 31 on the grounds of ill health. Consequent upon Mr. Taylor's retirement, the following appointments have been made with effect from January 1: **Mr. James Carr,** M.B.E., M.C., A.M.I.MECH.E., M.INST.GAS E., General Manager, Northern Division, to be Area General Manager at area headquarters, Bath. **Mr. L. P. Ingram,** M.B.E., M.SC., A.R.I.C., M.INST.GAS E., Deputy General Manager and Manager of the Taunton Sub-Division, to be Divisional Manager, Southern Division. **Mr. W. J. Baker,** M.I.MECH.E., A.M.I.CHEM.E., M.INST.GAS E., Manager, Weston-super-Mare Sub-Division, to be Divisional Manager, Northern Division. **Mr. T. M. Dent,** A.M.I.MECH.E., A.M.INST.GAS E., Production Engineer, Northern Division, to be Manager, Weston-super-Mare Sub-Division. **Mr. T. W. Jackson,** A.M.INST.GAS E., Distribution Engineer, Southern Division, to be Manager, Taunton Sub-Division.

Obituary

Mr. W. G. Swain, a Director of Lancashire Dynamo Holdings, Ltd., and Managing Director of Crypto, Ltd., died suddenly at his home on January 2. Mr. Swain, who was born in 1896, became associated with the Lancashire Dynamo Group in 1932 when the speciality machine section, manufacturing food preparing machinery and catering equipment, was inaugurated. In 1946 when Crypto, Ltd., was established as a subsidiary Company, he became its first Managing Director. The growth of Crypto, Ltd., both at home and abroad, may be traced to his foresight, energy, imagination and leadership.

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The death is announced of **Lieut.-Col. S. T. Maynard,** T.D., J.P., Chairman of the Burgess Hill Water Company for the past 40 years and a prominent Sussex solicitor. A past President of the Law Society of England and Wales, Colonel Maynard had devoted his life to public service, and county and local organisations will miss his counsel and experience. He became a Director of the Burgess Hill Water Company and the Burgess Hill and St. John's Common Gas Company in February, 1892, and was appointed Chairman in June, 1910. His association with the Gas Company terminated with the nationalisation of the gas industry, and only recently did ill health compel him to relinquish the Chairmanship of the Water Company and further prevent him from actively attending to business and public affairs.

Diary

Jan. 12.—Western Juniors: Visit to Taunton gasworks, 2 p.m.; Special General Meeting, 34, Bridge Street, Taunton, 3.15 p.m., followed by students' papers, 'Some Factors Influencing the Control of Calorific Value on Small Works,' G. J. Collins (Bath), and 'Installation of Boilers at Taunton Works,' Brian Francis.

Jan. 14.—West Midlands G.C.C.: Dudley Room, Queen's Hotel, Birmingham, 2.30 p.m.

Jan. 15.—London and Southern Section, I.G.E.: 'Industrial Applications of the Gas Turbine,' A. W. Pope (W. H. Allen, Sons, & Co., Ltd., Bedford). 17, Grosvenor Crescent, 2.30 p.m.

Jan. 15.—Chemical Engineering Group: 'The Patent Act of 1949,' Norman Brown. Burlington House.

Jan. 15.—Institute of Fuel: 'Llandarcy and Fuel Efficiency.' R. B. Southall. Institution of Mechanical Engineers, Storey's Gate, S.W.1, 5.30 p.m.

Jan. 16.—Eastern Juniors and London and Southern Juniors: Joint Meeting. Visit to Chelmsford.

Jan. 16.—Scottish Juniors (Eastern): Visit to British Petroleum Chemicals, Ltd., Grangemouth.

Jan. 16.—Scottish G.C.C.: Caledonian Hotel, Edinburgh. 11.15 a.m.

Jan. 16.—South Western Section, I.G.E.: 'Corrosion, its Causes and Prevention,' Dr. A. Marsden, M.B.E., M.SC., Area Scientist. At Exeter.

An Open Letter from

ONE PUBLICITY MAN TO ANOTHER

THE Editor invited me to preach a New Year sermon to the gas industry's Press Officers. But the only text I could think up on the spur of the moment was Samuel Butler's epic comment: 'The most important services rendered by the Press is that of educating people to approach printed matter with distrust'—which somehow did not seem appropriate to the theme the Editor had in mind. So I agreed to write an open letter to Press Officers—which has the additional merit of enabling the Editor to shelter behind the fact that any similarity between his views and mine is purely coincidental.

Now lest any of you imagine that I am not addressing myself to you personally, let me make it clear right away that for Press Officer also read Publicity Officer, Public Relations Officer, Press Agent, and all the rest of you chaps whose business it is to blow the gas industry's trumpet or publicise the activities of your particular board—for after all we are all members of the same club (of which it has been unkindly remarked that Ananias is the honorary president). Again, I am also talking to those gas boards which have so far decentralised themselves that they have been left without a press or publicity officer at all (which is a bad thing because they are left with a lot of people who have something to say but are frightened of saying it and others who have nothing to say and keep on saying it). I will address you for the sake of simplicity by an all-embracing pseudonym—

Dear Mr. Profficer, I have had the opportunity of looking through much of the material you have submitted to the Technical Press during the past year and, incidentally, of noting a good deal of material which you should have submitted but didn't. First of all, I should make it clear that a specialised trade paper cannot, like the Daily Press, maintain its spies in every town; and consequently it must rely on the co-operation of the industry's publicity officers for many of its news stories. There are several ways of presenting your story, but if there is one way better calculated than all others to make the Editor see red it is to submit it in obviously duplicated form and bearing the annotation 'General Release' or 'For Immediate Publication'—because he knows that all papers will probably be served with exactly the same thing. If the story you send him is not different or original, at least you can try to make it look so.

In the good (or bad, according to which way you look at it) old days, I gather that when, for example, the Little Ditheringham Gaslight Company opened a showroom or put up another retort it proudly sent the Gas Press an account of the event with quite decent photographs of the new plant or premises—which were duly published in the belief that this indicated the industry's progress in matters small as well as large. To-day when the Little Ditheringham unit (of the Great Booming Group of the Central Division of the North Severn Gas Board) has a similar event, there is an all-powerful, and often all-suppressing, publicity officer who takes it upon himself to decide whether the details are of any interest to the gas industry.

Are you of the breed which squashes the small news item because you consider it beneath your dignity to release it? If, in your omnipotence, you decide it is worth mention you send up a copy of your 'general release' which is at pains to explain that the new plant takes the form of 'a vessel in which the coal is baked to produce gas and many other useful by-products' and goes on to shoot the old line about the wonderful service the gas industry is performing for the community at large and the people of Little Ditheringham in particular. Good stuff for the *Little Ditheringham Weekly Clarion*, on whose front page the mayor, complete in chain of office, is prominently featured (in company, of course, with the chairman of the gas board) pushing in the first charge of coal with a silver plated shovel, subsequently presented to him to decorate the mayoral parlour. It is hardly suitable, however, for the edification of M.Inst.Gas E.'s and other readers in the gas profession. What the Editor wants is a knowledgeable description of the new plant or, in the case of a showroom, information about the design, layout, and decoration, with photographs of interior and exterior or, better still, 'before and after modernisation.' He wants to interest his readers and does not always want to see the photograph of your chairman drinking a cocktail with the lady mayoress or self-consciously posed in the act of presenting 'a memento of the occasion' to the town clerk.

Are you that type of publicity officer who counts your successes by the number of times you can get your chairman's photograph into print—bread-and-butter stuff? Do you cut a notch in your walking stick to mark each occasion until you look as though you are going about with a totem pole? Have you, on the other hand, a policy fixation which makes you fear that some sinister interpretation of your board's policy may be read into the most innocent news item?

By this time, my dear Profficer, I expect I have succeeded in making you thoroughly indignant. I hear you asking: 'Why, if the Editor really thinks that, does he publish the stuff? He knows perfectly well where the "rejected tray" is.' The answer is simple. Can you imagine a trade journal, covering the day-to-day progress of an industry, consisting of nothing but technical matter? No, of course you can't; it would be heavy enough to sink a battleship and the trade journal would very soon go out of circulation. So in the absence of anything else he does his best with what you send him—and lives more in hope than expectation of something better in the future.

How often, too, does the first inkling of an item of real interest to the industry reach the Editor by way of your board's magazine—by which time the event is such ancient history that he has not the face to publish it. Remember, time counts for a lot in newspaper work. The Editor does not always expect to get a 'scoop,' but he does like to get hot news. Do you recall that exhibition which opened on Monday and your photograph of the gas stand did not reach the Editor till Friday afternoon? Not good enough, Profficer. You could probably have taken that photograph before the exhibition opened and got it to the Editor post-haste. If there is one thing an editor hates it is publishing an account of an event in one issue and—maybe as a mere matter of courtesy—a photograph of it in the next.

May I leave you with one thought for 1952? It is: Bombard the Technical Press with news items—no matter how insignificant to your way of thinking—of what your board is doing in *every* sphere of its activities. Notwithstanding your opinion of editors in general (I couldn't agree more) he, not you, is the final arbiter of the blue pencil and the ultimate judge of what is of interest to the gas industry as a whole. And send up *advance* information of impending events. You never know—he might be able to send a staff representative to cover them, which will save you the trouble of even trying to be original.

O'PRESSED.

BEWDLEY WORKS TO CLOSE

AFTER 14 years Bewdley's 2-acre gasworks, one of the oldest and smallest in the Midlands is to close. Its 1,500 consumers will be supplied by four miles of main from Kidderminster. The main laying began 18 months ago.

Before nationalisation Bewdley gasworks had been a private concern—almost a family business—for most of the Board members lived in the area and many of their parents and grandparents had also been on the Board.

The plant was opened in 1838, but the buildings are older. They were used as a vitriol works and traces can still be found of the railway which was used by mineral trucks from Wyre Forest. Bewdley was then a flourishing river port and the gasworks, on the banks of the Severn got coal by barge and sent out tar by the same method.

The town's gas street lighting system was one of the first in the Midlands, but the supply was subject to the whims of the river, which overflowed into the works frequently and put out the boiler fires. One of the most serious floods was in 1947, when Bewdley was without gas for seven days.

The most prominent technician connected with the works was Joseph Tangye, the Birmingham engineer who was a pupil of William Murdoch. When he was chairman of the Board 70 years ago, the whole system was overhauled and the gas supply was said to be the best in Worcestershire.

His daughter, Mrs. J. F. Parker, of Tickenhill, Bewdley, told our correspondent that the gasworks was her father's special hobby. There was no incandescent household lighting then, only fishtail burners. If the burner flame at home had too big a blue centre, her father would rush to the works to see what was wrong.

Blairgowrie Grouse

GAS was discussed at Blairgowrie and Rattray Town Council. Provost Gilmour said that, at a meeting of the Gas Consultative Committee at Dunfermline, he made strong complaint about two matters. The first was the price of gas—8s. 1d. in Blairgowrie as compared with 5s. 5d. in Perth. He considered that was too big a difference. When the Gas Board ceased production in Blairgowrie and took gas by a main from Perth, local people expected some benefit, but so far there had been none.

The quality of the gas was his second complaint. They were far from satisfied with the position, and felt they had been let down. He had been assured that these matters would be looked into.

Treasurer MacDonald said that since gas was taken out of local control, the burgh lost about £500 in valuation on the gasworks, and, this year, about £160 in rates. The Provost said they were getting the same gas as Perth and he could not see why there should be such a difference in prices. A member suggested that Blairgowrie was paying for the new main.

Gas for Five New Towns in Eastern Area

MUCH planning and forethought on the technical side have been necessary to deal with the supply of gas to the five new towns which fall within the area of the Eastern Gas Board. Both the feeder mains and the necessary distribution mains for the various estates in the towns are either in process of being laid or are being planned.

Increased gas manufacturing plant will be required to meet the heavy load which the new towns will impose, and it will be some considerable time, owing to the long delays in the delivery of materials, before this aspect of the work can be completed.

The work in connection with the Hemel Hempstead new town is the most advanced. In Essex the Board's integration scheme giving bulk supplies of gas to Kelvedon, Witham, and Braintree has been extended to Chelmsford so that there is now a manufacturing station at both the northern and the southern ends of the area covered by the system—namely, at Chelmsford and Colchester. It is proposed to extend the system to Maldon next year.

A new continuous vertical carbonising plant of 3 mill. cu.ft per day capacity was completed last summer at Chelmsford and the first section of 2 mill. cu.ft. capacity has been put to work.

In the Watford Division two carbonising plants have been completely constructed and were recently put to work, the first at St. Albans, which now has a modern plant of continuous verticals with a capacity of 4 mill. cu.ft. per day, and the second at Watford, a horizontal house of 2 mill. cu.ft. capacity with up-to-date Congdon equipment. A unique feature of the latter is that the two sections of the house are on different levels and the stoking machine is transferred from one to the other by means of a hydraulic ramp.

New Tar Company

Bristol and West Tar Distillers, Ltd., has been incorporated with a nominal capital of £100 as a wholly-owned subsidiary of Wm. Butler & Co. (Bristol), Ltd. Its first Directors are: Thomas Howard Butler, J.P., Eric Wakefield Butler, Eric Peter Butler, Thomas Cyril Gwyer Butler. This company will acquire and operate all the tar distilling interests of the parent company as from January 1, 1952, and the capital will, in due course, be increased to a sum commensurate with its trading and with the assets involved.

Owing to the ever-increasing activities in the tar distilling business, both on the sales and technical side, also for the sake of ease of administration, it has been found necessary to divide the operations of the parent company. The formation of the company is also an essential step towards securing the raw materials for the many tar products which have been associated with Wm. Butler & Co. (Bristol), Ltd., for so many years.

Cumberland Gas Supplies

Speaking at a gas cooking demonstration at Workington, Lord Adams, a member of the Northern Gas Board, said that Workington would become the centre of Cumberland's gas industry. Workington obtains its gas from the United Iron and Steel Company's coke ovens and Lord Adams said the Gas Board had contracted to take 900 mill. cu.ft. per annum from the plant compared with the present 150 mill. cu.ft. The gas grid was to be extended from Workington to include Whitehaven, the whole of Ennerdale rural area as far as Sellafield, and the towns and villages to the east as far as Carlisle. This plan would mean the end of certain other gasworks. Lord Adams said the Gas Board had been allocated £3 mill. for developments and a substantial part of this would be used in Cumberland.

RADIATION STAFF DINNER AND DANCE

Members of the staff of the Midlands group of factories of Radiation Ltd. were invited by the Directors to a dinner and dance at the Tower Ballroom, Birmingham, on December 20. Our photograph was taken on the occasion.

NEW BUILDING CENTRE HEATED BY GAS

OUR editorial columns this week include comment on the Building Centre's new premises at 26, Store Street, W.C.1. The following notes serve to sketch in some of the details of this impressive building, one of the first in London of reinforced concrete.

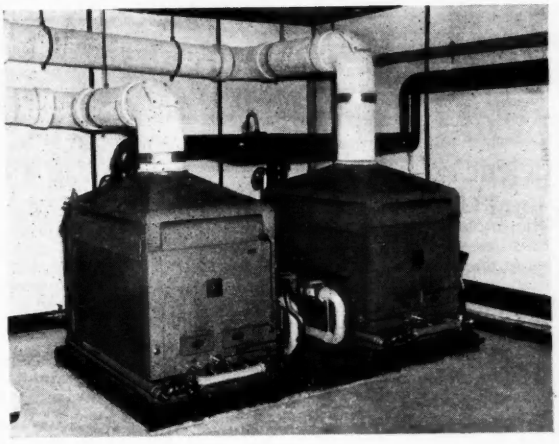
Accommodation is spacious. There are exhibition areas on all floors, offices connected with the information service being grouped near the entrance hall on the ground floor. Main administrative offices with the council room are on the second floor, and the lecture room and hall for exhibitions above.

From the viewpoint of the gas industry, the most interesting feature (apart, of course, from the gas section itself, at present in temporary form) is the boiler room and heating plant, planned as an exhibit with glazed doors and a large window to the main exhibition. The central heating plant consists of two De La Rue (Potterton Gas Division) boilers with a control system by the Rheostatic Co., Ltd.

A normal heating installation is designed, so that when it is freezing outside the boilers operate at a temperature of 180°F. As the outside temperature rises, lower boiler temperatures can be employed, but if this change of boiler temperature is not automatically obtained wastage of gas results. Accordingly a compensator equipment has been installed, serving as a weather sample. Fitted to the outside of the building this instrument transmits back to the boiler room the outside temperature, making automatic adjustments to the boiler temperature according to the outside conditions. Thus a rise in external temperature produces a fall in the boiler temperature, and *vice versa*.

In order to prevent waste of gas when the building is not in occupation a system of time clock control has been installed, which shuts down the plant each day, from Monday to Friday, at a predetermined time and on Saturday at midday. So that the building may be comfortable by the time of re-opening, the time clock system re-starts the apparatus at varying times in the morning; the colder it is outside, the earlier the plant is started. Because the plant is shut down during periods of non-occupation, it is possible that in very severe weather a freeze-up might occur and cause damage to the apparatus. To prevent such an occurrence a further thermostat is installed in the exhibiting spaces which over-rides the normal system of controls and restarts the plant before the temperature inside the building reaches freezing point.

The boilers are fitted with safety devices, including automatic controls which would shut down the boilers in the event of a gas failure and, when the gas supply is restored, would stop the passage of gas to the boilers until they were re-lighted manually. As the boiler room is in a position where there is no natural ventilation, air for combustion is obtained by a ventilation system.



A view of the two De La Rue boilers installed at the Building Centre's new premises at Store Street, W.C.1. With its elaborate system of automatic controls this installation is one of the principal exhibits at the Centre.

Radiators, pipe fittings and valves are by Crane, Ltd., air filters by Fibreglass, Ltd., and the plant was designed and installed by Troughton and Young (Heating), Ltd.

BATH HEADQUARTERS

WITHIN 18 months, the South Western Gas Board hopes that much of its Bath sub-divisional headquarters will be able to move out of the old Bath Gas Company offices in Old Bond Street. All the distribution staff will then be transferred to a new block of offices behind St. Mary's Church, Bathwick. When the full scheme is completed the Bath sub-division office staff will move to the new premises, leaving the South Western regional staff at the Old Bond Street premises.

The Board at present has permission to spend £90,000 on the first two stages of the scheme. A third and final phase which will complete the building as sub-divisional headquarters, is on the drawing boards, but will not be put into operation for some considerable time.

Mr. G. F. Oliver, Planning Engineer, has stated that when it was known that nationalisation was coming one of the first steps was to set up a headquarters for the gas industry in the South West, reasonably in the centre of an area extending from Land's End to Lyme Regis, to the west to Newbury and to a northern extremity of Evesham. The choice lay between Taunton, Bath, and Bristol, and Bath won because of availability of accommodation and easy access to London. Had any other centre been chosen it would have meant the erection of completely new headquarters, or the acquisition of a large old house or mansion. The final compromise was actuated by the Chairman, Mr. C. H. Chester, who asked the Manager of the Bath sub-division, Mr. C. P. Bateman, to move over and make room at the old Bath Gas Company's offices.

The headquarters will eventually be a three storey building of Bath stone which will house stores, cooker and water heater repair workshops, garages, a drawing office, fitters' lobbies and cloakrooms. The gas showrooms, however, will remain in Old Bond Street.

Apprentices' Meeting

THE annual meeting of the apprentices of Robert Dempster & Sons, Ltd., Elland, was held on December 28. After dinner, Mr. B. C. Morton (Managing Director) who presided, presented prizes to the apprentices for the year's achievement in practical and technical work. A programme of entertainment was produced by apprentices J. Whitworth (violin), G. Mallinson (pianist), and E. Slide (comedian), concluding with community carol singing.

Mr. Morton outlined the technical and welfare facilities offered to apprentices and urged the boys to make full use of them. The apprenticeship committee of executives was appointed to watch carefully the progress and welfare of all boys individually, and he wanted the boys to feel they could approach committee members confidently with any problems or doubts regarding their careers or even more personal difficulties. The Company would honour to the letter all promises and agreements and no apprentice would be let down.

He urged the boys to exert the greatest possible endeavours, aim for the highest achievements, and nothing less, take nothing for granted, but insist on discovering the 'why and wherefore' for themselves.

Prize winners were: J. N. Mitchell (with special merit prize), R. Milnes, H. Beverley, P. B. Dean, C. A. Williamson, J. D. Robinson, D. Cockcroft, D. Wright and G. Littlewood.

CROYDON'S MAIDEN VOYAGE

THE South Eastern Gas Board's latest collier, *M.V. Croydon,* completed her maiden voyage from the north-east coast to Wandsworth on December 19. The Board was honoured by the company of Alderman and Mrs. L. A. Aston, Mayor and Mayoress of Croydon, who, with Mr. W. K. Hutchison, Chairman of the Board, and Mrs. Hutchison, who launched the vessel, went by launch from Westminster Pier to West India Dock Buoys and then came up river on the *Croydon* to Wandsworth.

In a speech of welcome, Alderman L. A. Aston thanked the Board for naming the ship *Croydon.* They were very pleased because Croydon was so closely allied to the coal industry. Croydon was, in the 18th century, the colliery of London, and supplied all the charcoal that was necessary to keep London warm. Quite near where he lived there was a road called Colliers Water Lane. It was in that road that the old colliers actually lived. He wished the Captain and crew and all who sailed in the new vessel the best of luck for safe journeys.

Captain Norman Carr, the ship's master, said the *Croydon* was the latest unit in a fine fleet of ships. He thought it would be as good as—he had better not say better than—any other.

Falk Stadelmann Party

Falk Stadelmann & Co., Ltd., held their chillдren's Christmas party in the staff canteen, Farringdon Road, on December 29. Nearly 100 children warmly welcomed Father Christmas, who presented each with a toy and traditional Christmas gifts of fruit and sweets. Entertainment was provided by Punch and Judy, a conjuror and ventriloquist, followed by party games. Tea, cakes, and ice cream were consumed in large quantities.

The party arrangements were in the hands of Miss Furness and Mr. Powell, acting on behalf of the Veritas Efesca Social Club Committee.

Improved Efficiencies at Blackpool

Blackpool gasworks cost £60,000 less to run during the past year than in the year before nationalisation, although it carbonised 4,131 tons of coal more (114,770 tons against 110,639 tons), and produced 655,238 therms more of gas (11.335,298 therms against 10,680,060 therms), and 13,417 tons more of coke (40,941 tons against 27,524 tons).

The saving, Mr. J. G. O. Drake, Fylde Group General Manager of the North Western Gas Board, stated on January 3, was due to greatly improved technical efficiencies achieved during the last 2½ years as a result of which each ton of coal carbonised yielded 1.36 therms more of gas and 2.15 cwt. more of coke, while oil consumption was reduced by 4 gal. per ton of coal carbonised.

During the past year three towns in the Fylde—Thornton-Cleveleys, Fleetwood and Poulton-le-Fylde—have been connected with Blackpool by high pressure arterial mains in an extensive gas grid. The new grid, with which Kirkham and Lytham St. Annes also are to be connected eventually, will be opened officially in the near future.

Safety Colour Code

DURING recent years industry has given increasing attention to colour coding of danger points in factories to indicate high voltage lines, toxic gases, and obstructions such as low doorways and steps and other varying degrees of hazard, and a Committee of the British Standards Institution, representative of a wide variety of experience, has been considering the possibility of preparing a safety colour code in order to secure unification of present practices.

The Royal Society for the Prevention of Accidents made an extensive enquiry on behalf of the committee, as a result of which and of other investigations, it has now been decided to abandon the attempt to prepare a code.

Examination of the problem showed that a distinction must be made between a *safety* colour code and an *indentification* colour code—the purpose of the former being, broadly, to classify types of hazard and to give warning of them by colour, while the object of the identification code, as in the British Standards 1710 for pipe lines and 349 for gas cylinders, is primarily to identify by colour the contents, and any application to safety is incidental.

It was the former type of code that the committee had to consider, and it was found that many colours had traditional connotations, which while not always consistent, were so well known that they could not be reconciled.

The second difficulty was that the only truly satisfactory method of ensuring safety is to eliminate the hazard, and the committee felt that a code might encourage identification of hazards by colour instead of their removal.

Thirdly, the increase in the scientific use of colours for decoration to secure better light and to improve working conditions detracted from the effectiveness of a safety colour code, and these schemes of colour treatment were considered to be more effective in the reduction of accidents.

A fourth and important point arose from positive evidence submitted showing that the significance of colour codes put into effect had been quickly forgotten; while this is relatively unimportant in the case of an identification colour code where time is not vital, it was felt to militate seriously against the use of a safety code where recognition and significance of colour must be immediate and instinctive.

Publications Received

FROM the Canada Department of Mines and Technical Surveys we have received a copy of 'The Canadian Mineral Industry in 1949.' This report contains reviews by the staff of the Mines Branch of each of the 57 metals, fuels, and minerals that were produced in commercial quantities in Canada during the year. A review of the mineral industry as a whole for 1949 is given in an introduction to the report. Coal production reached a new peak of 19,120,046 short tons, an increase of 3.6% over that of 1948. Alberta contributed 45% of the output and Nova Scotia 32%. Canadian consumption was 39,938,000 tons. Coal processed for the manufacture of coke amounted to 5,174,176 tons. Imports of coke totalled 716,160. Petroleum coke produced at the refineries amounted to 117,369 tons. Coke production units include seven by-product coke oven plants, two beehive plants, one Curran-Knowles installation, seven continuous vertical retort plants, and eight installations of horizontals.

* * *

The Ministry of Fuel and Power Statistical Digest, 1950, is now available (H.M. Stationery Office; 15s.). It follows closely the 1948 and 1949 edition which was published in 1950, the format and sequence of the tables being maintained as far as possible in order to facilitate reference. The tables showing the availability and consumption of coal give particulars for each of the regions used by the Ministry of Fuel and Power for administrative purposes. The geographical analysis of gas and electricity statistics and also of coal production statistics is given on the basis of the divisional and area organisations of the national authorities.

Gas Coke Price Increase

Mr. Geoffrey Lloyd, the Minister of Fuel and Power, last week confirmed an increase in the price of gas coke as from Monday, January 7. Increases will vary from 6s. 8d. to 10s. per ton. In areas of the North Thames, South Eastern and Southern Gas Boards the rise will be 8s. 4d. per ton.

A representative price for coke in London, including the increase, would be £5 11s. 6d. per ton, stated a Ministry of Fuel and Power official. The higher rates are a result of the 10% railway freight rise and the higher coal price announced by the National Coal Board.

The price of hard coke was increased on December 31 by 8s. 8d. per ton, ex works, plus charge increases ranging from 1s. 1d. to 3s. 4d. per ton.

EFFLUENT LIQUOR PURIFICATION

By C. COOPER, M.Sc., M.Inst.Gas E.,
Director and Head of Technical Department, and
W. E. BOUCH, B.Sc.,
Research and Development Department, W. C. Holmes and Co., Ltd.

In this paper (abstract of the I.G.E. Publication No. 399) to the Institution of Gas Engineers the authors discuss the possibilities of using nitric acid and nitrous acid for the destruction of the residual toxic matter in ammonia still effluents and other effluents from gasworks.

THE alternatives normally confronting a gas undertaking that will have effluents for disposal are broadly between handing over the distilled ammonia still effluent, plus other drainage, such as from purifier siphons, to a local authority for treatment along with other wastes, or to give to such effluents such treatment as will relieve the gas undertaking of, at any rate, the heaviest charges that may be imposed by such an authority. The authors agree that these do not exhaust the alternatives, as there are, for example, undertakings that have, so far at any rate, relative freedom to dispose of their crude liquor or effluent into the sea.

An undertaking normally placed would naturally favour a partial treatment that permitted of such reduced charges, and which might be expected to be operable, if not at a profit, at an overall cost such as would make the sum of the charges less than those required for complete acceptance by the sewage authority.

The above statement includes the possibility of extracting phenolic matter for sale, by processes of dephenolation, and the possibility of extending the treatment of the liquor so as to recover the fixed ammonia salts, more particularly ammonium chloride, as a relatively pure substance. The authors do not propose in this paper to describe the extensive treatment, proposed by Nicklin[1], which has been incorporated into the first section of the new works at Tingley, as this has been dealt with previously. The plant at the time of writing this paper has not yet been put into action.

Cost Considerations

This is one of the most difficult assessments to make. Since the writers were concerned in the construction of modern plants (for example, for dephenolation and ammonium chloride recovery), equipment costs have risen measureably, as have also the revenues available from the recovered products.

The paper given by Bondy and Priestley to the Coke Oven Managers' Association in April of this year[2] indicated that an exhaustive dephenolation treatment could be given to an aqueous liquor at a cost of approximately 20s. per 1,000 gal., and that thereafter the net cost could be calculated by deducting the value of the crude acids recovered. It was also indicated that, for many such liquors, the necessity for such exhaustive treatment did not appear (as, for example, with a coke oven liquor containing 3 grammes per litre or less of phenols—largely monohydric phenols, as contrasted with the Bolsover figures of 12 grammes per litre of a highly complex mixture, including polyhydric phenols). In the former of these cases a dephenolation effect of 75% might go a long way with low capital cost, whereas at Bolsover 95% removal was desirable.

Crude phenols derived from extraction plants may vary considerably in their market value. Not a great deal of neutral oil can be tolerated therein; otherwise the purchaser has to perform the full re-extraction process with soda treatment, so that only acidic material is ultimately recovered. This requirement is observed more readily when the second stage of dephenolation—that is, the recovery of the phenolic material from the extract—is carried out by the soda wash process itself, and less readily when the phenolic material is recovered by a process of distillation of the solvent from the acids.[3]

Within these wide limits, it may be assumed that the sale value of recovered phenols may vary between 3d. and 4d. per lb.

Having considered the dissolved organic material in the liquors available, the authors now have to deal with the inorganic content, which may be more intractable. Ammonium chloride does not contribute (according to normal standards) to the toxicity of the ultimate effluent, but, as pointed out by Nicklin, it can be caused to contribute heavily to the recovery of the costs of a full treatment. The market price of ammonium chloride of reasonable grade is at the present time about £25 per ton. This may well represent a gross figure of £2 to £3 per 1,000 gal. of liquor treated, which would have to cover the cost of evaporation of the liquor, which may well contain less than 2% weight of the desired salt.

Biological Treatment

The possibility of a wide variation in the costs that will make a liquor acceptable to a local authority must regretfully be admitted. A number of contracts for acceptance of such liquors are, it is understood, being made on the basis of pounds of oxygen involved, expressed in terms of the O/A figure of the liquor accepted, which contracts may include provisions for acceptance at a reasonably regular rate, so that there can be the maximum of continuity and the minimum of excess at any given time. The necessity of special arrangements at the receiving end may vary greatly.

Finally, there is a group of cases wherein local authorities, whatever may be their technical views on the matter, are unable or unwilling to accept any notable increase of toxic matter in effluent liquors from gas undertakings. While one may suspect that, in some of these cases, the feeling may be non-co-operative, it would be unwise not to admit the probability that in the majority of cases the difficulties are real, and the fact that where such an authority or rivers board may have to accept a certain degree of other polluting matter of a domestic or local type, its internal economy would be upset by addition thereto of chemical effluents from gasworks or other sources.

A recent author[4] has indicated that some of the differences of opinion, as to the damage done by gasworks effluents, may be due to mistaken conclusions. Studying a particular case he has come to the conclusion that the dissolved matter, such as phenols and thiocyanates, may be far less important in a treated sewage than the suspended matter escaping settlement and filtration. This is, on the face of it, only a minor matter compared with the importance of reducing the heavy oxygen-absorbing power of crude effluent, but it will be clear that if the policy of pre-treatment is favoured at the gasworks, for the purpose of minimising the assessed charges for treatment, it may be important to know how far the residual toxic matter is actually liable to influence the ultimate purity of the biologically treated total effluents.

Finishing Treatment

The treatment of other dissolved materials, such as inorganic salts, which contribute to the toxicity, and which, unfortunately, may be left in solution when even the most careful pre-treatments are applied, has not been contemplated to any notable

degree. These materials are usually represented by the thiocyanate and thiosulphate of ammonia, and are not minimised even by the completion of the ammonia distillation with lime. Certain proposals have been made for the removal of these salts, particularly by ion exchange on resins, but little appears to be known of this process except through patent literature. Such a solution of salts is left also when ammonium chloride is exhaustively removed, for revenue purposes, either on the lines of the former large installation at the Corby coke ovens, or the new installation at Tingley. Both the ammonia salts cited are of a high solubility, and ultimately form, in such circumstances, a useless mother liquor, which has to be disposed of without its toxicity having been minimised.

A similar collection of salts is available from purifier siphons, and from the purge liquor from the liquid purification plants that use alkaline reagents, generally derivative from the Seaboard process.

Chemical Oxidation Treatment

If nitric acid is caused to react with the two inorganic salts previously mentioned, the thiocyanate and thiosulphate, the products of the oxidation that remain in solution are non-toxic, being chiefly ammonium sulphate and sulphuric acid. The reaction being carried out at or near boiling temperature, the reduction products of the nitric acid pass off as gases, primarily as nitric oxide, but this is mixed with hydrocyanic acid and, possibly, minor proportions of other gases. This reaction, as far as it applies to thiocyanate, has been known for a considerable time, and a large-scale manufacture of hydrocyanic acid in this way was described in the *Journal* of *the Society of Chemical Industry* as far back as 1899[5]. The reaction in question is also used as a quantitative method of estimation of thiocyanate.

What is important for present purposes is that nitric oxide can be reconverted to more oxides of nitrogen, and, in fact, ultimately can be recovered as nitric acid again. Thus, the destruction of thiosulphate and thiocyanate would have a negligible reagent cost.

We have already cited another form of effluent which is of a difficult character and of universal expectation, which is the drainage from oxide purifiers. In so far as this material consists of oxidisable salts, it can be dealt with by the reactions mentioned.

As previously noted, the second attraction of this proposal is the fact that a mixture of oxides of nitrogen is readily

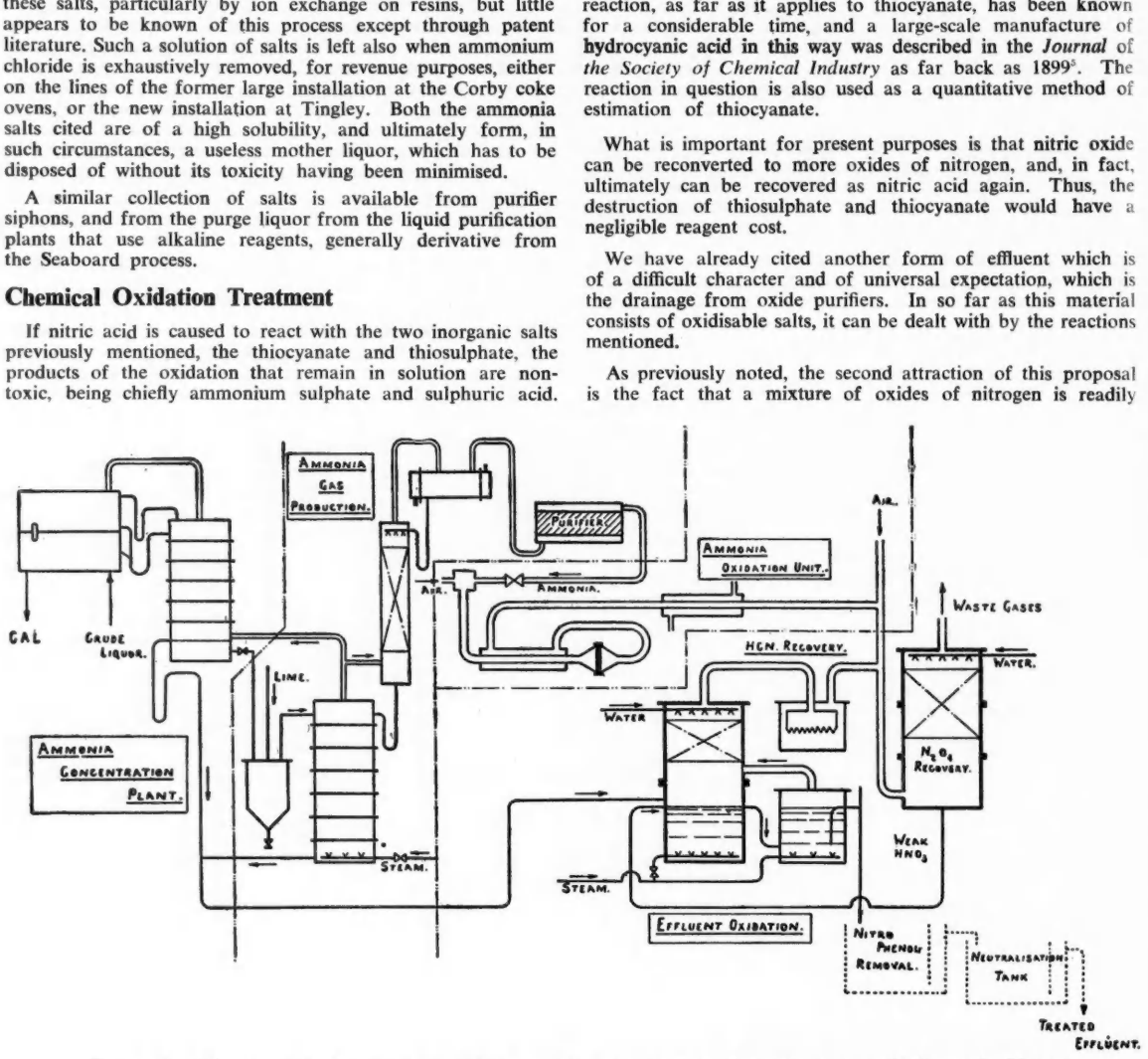


FIGURE 1.—*Diagrammatic Layout Suggested for a Plant for the Complete Treatment of Ammonia Liquor.*

This is a representation of a possible scheme of complete ammonia liquor treatment, and goes rather beyond the pilot plant work so far carried out. Beginning with a crude concentration plant, it may be desired to obtain ammonia gas for the ammonia oxidation plant from the actual works production of ammonia, in which case the necessary proportion of the fixed liquor would be passed into a liming still and a comparatively pure steam-ammonia mixture evolved. The difficulty of control of ammonia quantity prescribes that provision should be made for returning an excess of ammonia so produced to the main liquor concentration plant. The steam-ammonia mixture is enriched by fractionation, and after being brought to atmospheric temperature requires purification from volatile organic matter. In this condition it is suitable for the ammonia oxidation treatment.

For the recovery purpose the gas as directly evolved from the treatment of thiocyanate with nitric acid should be employed, as it is desired that the gas mixture should be free from oxygen and as concentrated as possible in hydrocyanic acid. Any air that enters will tend to form nitrates and nitrites as impurities in the cyanide.

In these circumstances, hydrocyanic acid can be absorbed in comparatively pure state in caustic soda to form sodium cyanide, which is one of the normal cyanide products. The solution, which would probably be the most convenient way of handling for sale, should be as concentrated as possible.

It is very likely that the recovery of hydrocyanic acid could only be done effectively when treating a fairly concentrated solution of fixed ammonia salts, and not the average-make liquor of the works, but the suggestion is included in this diagram to indicate the appropriate point. The total quantity of thiocyanate could be enhanced by including purifier drainage, and, if available, mother liquor from ammonium chloride production, when handling a crude effluent that is otherwise low in thiocyanate content. The relative concentrations would vary considerably from one works to another.

obtainable in small or large quantities, from ammonia itself. It is true that the ammonia, in order to be economically convertible into nitrogen oxides, must be of a relatively high purity. It is not difficult to make a small quantity of ammonia gas of such a purity in any ordinary ammonia distillation plant, but the conversion of a great part of the ammonia product of the works to pure ammonia is not so simple or inexpensive. One has therefore to consider what would, in actual fact, be the requirement of nitric acid, nitrogen oxides, or their equivalent in ammonia, in order to deal with a typical ammonia still product. At this point comes consideration of the residual phenolic matter dissolved in the effluent liquor.

This may be a large amount (as, for example, from a liquor effluent from continuous vertical retorts that has not had any phenols extracted), or it may be of the order of one-tenth of this amount, in a still effluent from a liquor that has had previous treatment for the removal of phenols.

It will be seen from what follows that the result of treating liquors containing phenols with nitric acid and similar substances is that a definite proportion of the reagent is found to combine with the phenolic matter in a form that is such as to render the nitric acid non-recoverable. This, therefore, is one of the charges on the process. It is true that the soluble compounds so formed are removable, and it is unlikely that their presence in the treated effluent would cause any embarrassment in the quantities that may be anticipated.

A simple estimate of the available reaction material that would be taken away by phenolic matter can be made as follows:—

If one considers an effluent liquor that contains 4 grammes of phenol per litre, the equivalent weight of ammonia lost if a mono-nitro compound is formed is only about one-fifth its weight—say, 0.8 grammes per litre. The initial ammonia content of 1 litre of crude liquor might be as high as 20 grammes, or 15 grammes per litre of effluent.

The Process Itself

There would be required (see Fig. 1):—

(1) Main reaction vessel of stoneware, into which the material enters and is kept boiling with steam to promote the reaction with nitric acid. Very probably, two or more such vessels in series would be advisable in practice to reduce the possibility of material passing through untreated.

(2) A neutralising and settling vessel, which in certain circumstances might conveniently be made of steel.

(3) Apparatus for cooling the vapours evolved from the main reaction vessels, and effecting the conversion of nitric oxide to peroxide, or to nitrous and nitric acids in solution.

(4) Means for disposal of the waste gases containing hydrocyanic acid, involving either the recovery of the latter as cyanide, or its destruction.

Immediately on setting out this scheme, the suggestion arises that, in the vessels (which are scrubbing towers) wherein the reconstitution of the nitrogen acids takes place, it is feasible to carry out a part of the main reaction instead of adding the liquor to be treated directly to the main vessel. At any rate, the outgoing waste gases could obviously be washed with incoming effluent in order to promote more complete recovery of the nitrogen acids.

The procedure as described above contemplates a continuous addition of nitric acid to make up the losses. The authors have considered the possibility of supplying the nitrogen oxides direct from an ammonia oxidation unit.

The list of plant items above already incorporates an oxidation and absorption train, and such equipment is necessarily called for if the product of ammonia oxidation, which is nitric oxide, is to be effectively used. According to all the information in the possession of the authors, the working size of the ammonia oxidation unit would be small in comparison with the total ammonia turnover of the plant.

Phenolic Matter

Seeing that nitric acid tends to form comparatively stable nitration products with phenols with no recovery of nitric acid, there is no doubt of the advantage of dealing with liquors that have previously been dephenolated. One has, however, to consider the scale of operations.

Even if it were shown that dephenolation was (in an appropriate scale of working) economically justifiable, the fact must be accepted that very considerable capital sums and equivalent construction capacity would have to be made available to cope with the quantities of liquor being produced in all parts of the country. It is improbable that isolated works of medium and small size would, in any case, be able to justify such extraction plants.

It is therefore proper to investigate what is likely to happen when the oxidation treatment, which is primarily directed against the inorganic salts, is applied to liquors containing organic material of the phenolic type. The products appear to be very mixed, and undoubtedly contain mono-nitro compounds that exhibit themselves as being volatile in steam; but there are other and less volatile compounds that remain in solution. It will be noted that the oxidised solution has acquired sulphuric acid from the decomposition and oxidation of inorganic salts, and experiment has shown that the nitro compounds of the phenols can be removed at boiling temperature (which is the normal condition of the oxidised liquid) by activated carbon from acid solution. This part of the investigation has not been carried as far as would be desirable, but it appears that a carbon that has taken up its appropriate quantity of the nitro-phenols can be extracted by an alkaline solution, and the carbon put back to duty. What is to be done with the soda compounds of the nitro-phenols is another matter. They are not very soluble in water, so a highly concentrated solution is not obtainable. It would appear that the simplest way of disposal would be by evaporation and burning of the residue.

In the absence of this particular solution the nitro-phenols would pass out with the treated effluent, and enter either a sewage system or a water course.

The disposal of nitro-phenols by these channels was made the subject of a special study during the second world war, as discharges were inevitable from munition plants manufacturing nitro-phenols as explosives. This subject is dealt with in some detail by Southgate[6].

According to Southgate, poly-nitro-phenols up to two parts per 100,000 create no difficulty in domestic sewage treatment, and the limit of toleration is not stated. Unsatisfactory sewage treatment is, however, reported with five parts per 100,000 of poly-nitro phenols.

The toxicity to fish is put at about three parts per 100,000 when in the presence of treated sewage. The toxicity of this proportion is reported to be rather less when the diluent is clean water.

It should therefore be considered how these proportions meet with the probability of discharge of a still effluent containing nitrated phenols. Such an effluent is likely to contain, after allowance has been made for phenols volatilised in the still, and the dilution of the bulk that occurs therein, 200 parts of phenol per 100,000. If a figure of 250 parts of nitro-phenols per 100,000 be taken when the phenols are in this state, it appears that it would be advisable to effect a dilution of 150 to 200 times before entering a sewage system, and this is, in fact, somewhere near what is considered tolerable as a proportion of still effluent under normal effluent disposal conditions.

In the case of discharge into water courses, the effectiveness of dilution would have to be more rigidly guaranteed, as the possibility of failure to dilute to this extent in dry weather conditions is present.

Any work that is done to reduce the original phenolic content of the ammonia liquor or the effluent will naturally react very favourably to these possibilities.

It still has to be pointed out that if activated carbon treatment were applied and proved successful, the limits of toleration

cited above would be met with very considerable margins, after normal dilution.

Here the authors have to report one of the possibilities, which has arisen in the course of the examination of the chemical reactions. If the reagent for the treatment of liquors containing phenols is nitrous acid, or gases capable of yielding this substance, one of the products appears to be a stable compound, *p*-nitrosophenol. It is notable that the reduction of O/A value when using nitrous acid to treat the pure phenol is greater than if the reagent were nitric acid. If the procedure follows the lines of Fig. 1, nitrous acid is very likely to be present, and experiment has shown that the greater reduction of O/A derived from phenolic substances by nitrous acid occurs also in the presence of the mixed acids. It is unlikely that the considerable reduction in O/A value, amounting to over 60% when nitrous acid is used, represents actual decomposition of phenol, and the suggestion, therefore, is that some of these compounds are resistant to the permanganate reaction.

Variations of Procedure

In a considerable majority of gas-producing stations, it is possible to divide the resulting ammonia liquors into two strongly contrasting portions. The first of these is represented by the liquor derived from the retort house circulation, which tends to accumulate fixed ammonia salts, and reference to published analyses such as those provided by Key will also make it evident that the toxic salts predominate in these strong fixed liquors, as compared with the weak and strong free ammonia liquors later produced in the stream. These observations suggest that strong oxidation treatment might be most effectively applied to the retort house liquors, whereas dephenolation would be more remuneratively applied to the latter group. It would, however, be preferable that the fixed liquors containing chloride, etc., should be deprived of their free ammonia content before they are subjected to oxidation.

It will also be evident that, if the loss of a certain small proportion of nitric acid is inevitable in the oxidation treatment, it will be limited to possibly less than one-fifth of the gross volume of effluents being discharged, and will therefore not weigh so heavily in a cost sheet. Similarly, if the condenser liquor is dephenolated, containing as it does the major proportion of the phenols, and if such a liquor is afterwards submitted to oxidation treatment, the dead loss of nitric acid by the formation of nitro-compounds will again be minimised.

Scrubber liquor alone would not normally repay a dephenolation treatment, but it could be added to the dephenolated condenser liquors before passing to the main ammonia still.

Reverting once more to the treatment of strong retort house liquors, the published figures suggest that, if the recovery of hydrocyanic acid is to be carried out, these liquors would provide the most useful source, the treatment being strictly by nitric acid so that the volume of evolved gases would be at the minimum, rather than by the treatment in the gas phase with the mixed product of ammonia oxidation.

Removal of nitrated phenols by activated carbon was referred to a consultant with special knowledge of the use of activated carbons in water purification, and the results of his examination under laboratory conditions are summarised herewith.

Using 20 grammes activated carbon (Nuchar XXX) per litre, with solutions containing 3 grammes per litre of nitrophenols, in the presence of 0.1 N. acid:

		Content After Treatment (grammes per litre)	Removed (%)
Picric Acid	at 25°C. ...	0.065	98
Picric Acid	at 90°C. ...	0.022	99
p-Nitrophenol	at 90°C. ...	0.015	99.5
o-Nitrophenol	at 90°C ...	0.000	100

These extractions are, in the authors' opinion, more complete than will be demanded in practice. Furthermore, the use of 20 grammes per litre would be a little expensive, unless at least a life of 20 regenerations could be achieved, before falling off of activity resulted in a notable failure to remove the nitro compounds.

Laboratory Work

As was stated earlier, the main effluent constituents that it is desirable to destroy, assuming that removal is not to be practised, are thiocyanate, thiosulphate and, to a lesser degree, phenols. The authors' attention has been fixed primarily on thiocyanate, secondly on thiosulphate, and lastly on phenol. The investigations were carried out under a variety of conditions, in order to fix, as far as possible, optimum conditions for transference to the pilot plant-scale of operations. Thus, the oxidations were performed not only in air, but also in an inert atmosphere (nitrogen). Also, oxidations were performed in the presence and absence of ammonium chloride. Again, oxidations were performed using a solution substituting nitrous acid in place of nitric acid.

In transference to practice, one must keep in mind that an untreated effluent will normally be made available at or near boiling-point from such a discharge.

Solutions of thiocyanate, thiosulphate, and phenol were made up, each possessing a known O/A value, in this case 1,000 parts per 100,000. These solutions were treated with excess nitric acid or of nitrous acid in solution, under the various conditions enumerated above. The method of treatment was the same in all cases—namely, mixing of the reactants and boiling under reflux for 30 min.

The destruction of the effluent constituents was followed in each case by withdrawing at 5 min. intervals small O/A test samples from the reaction vessel.

Although chemical tests showed the destruction of thiocyanate and thiosulphate to be complete, on or before reaching boiling temperature, it was found necessary to boil for 30 min. to decompose and drive off all nitrous acid and oxides of nitrogen present as reduction products of nitric acid in the solution. When this was not done an abnormally high O/A value resulted, due to action of the above mentioned reduction products with the potassium permanganate used in the standard O/A test.

Oxidation of Thiocyanate

It is felt that this is not the time to survey fully the very extensive literatures on the detection, estimation and reactions of thiocyanates. However, in this paper the authors have included a number of selected references that have a particular bearing on the reactions with which they are concerned—namely, oxidation of thiocyanates and hydrolysis of the oxidation products. Here, however, mention must be made of the paper by Conroy[5] dealing with the Raschen process for the manufacture of hydrocyanic acid by the oxidation of thiocyanate by nitric acid. This process ran successfully, and the economics of the process were largely governed by the successful recovery of the oxides of nitrogen, which were repeatedly used to oxide fresh thiocyanate.

Thus, in view of previous work when the synthetic thiocyanate solutions were oxidised by excess nitric acid the reactions proceeded much as expected. The oxidations occurred at various temperatures, dependent on the concentration of nitric acid throughout the solution. Thus a solution 5 N. with respect to nitric acid would react in the cold if agitated, whereas a solution 0.2 N. with respect to nitric acid would only react at boiling temperature.

The reaction in all cases followed a well-defined pattern. Firstly, on mixing, the solution would turn pale yellow brown and, dependent on the concentration of nitric acid and the temperature of the solution, would turn to dark red as the oxidation occurred. This dark red coloration is probably due to nitrosyl thiocyanate ($NOSCN$)[7]. The dark red coloration disappears on completion of the oxidation, and its disappearance is followed by an immediate evolution of nitric oxide, which oxidises to nitrogen peroxide in air.

The test samples withdrawn at 5 min. intervals throughout the reaction period showed a very rapid reduction in O/A

value. Thus, a solution initially of O/A value 1,000 parts per 100,000 was reduced to six parts per 100,000 after 30 min. boiling. Tests with ferric iron showed that thiocyanate was completely destroyed immediately the characteristic break down of the dark red coloration had occurred. The lag in the fall of the O/A value was thought to be due to the somewhat slower break down and discharge from the solution of the reduced products of nitric acid.

When thiocyanate was oxidised by nitric acid in the presence of ammonium chloride, a figure of 1.5% W/V of ammonium chloride was chosen as being a typical value for a liquor. Very slight improvement in the O/A value of the final solution was noted. The O/A value of a 1,000 parts per 100,000 solution after 15 min. oxidation was 32 parts per 100,000, and after 30 min. oxidation four parts per 100,000. The difference here compared with oxidising thiocyanate in the absence of ammonium chloride is too small to draw any positive conclusion as to the beneficial effect of ammonium chloride in an effluent solution. However, it is likely that a little chlorine is liberated by the interaction of ammonium chloride, nitric acid, and sulphuric acid formed during the destruction of the thiocyanate. Other workers have shown that chlorine will oxidise thiocyanate[8, 9, 10], and the authors have confirmed this action in the laboratory.

If the oxidation of thiocyanate is performed in an atmosphere of nitrogen the reduction in O/A value obtained is not so good as that obtained when the oxidation is performed in air. Thus, after 30 min. oxidation in an atmosphere of nitrogen, the final O/A value is 16 parts per 100,000, against a figure of six parts per 100,000 in air. Similarly, in the presence of 1.5% W/V ammonium chloride in atmosphere of nitrogen, the solution after 30 min. reaction possessed an O/A value of 12 parts per 100,000 against a value of four parts per 100,000 when ammonium chloride is present and the oxidation is performed in air. This small difference suggests that a part of the oxides of nitrogen is returned to the solution as nitric acid, in presence of air.

Thus, to summarise the reaction of thiocyanate with excess nitric acid:—

Both in presence and absence of air and in the presence and absence of ammonium chloride, nitric acid will destroy all the thiocyanate present in a solution and reduce the O/A value of that solution to approximately one-hundredth of its initial value.

Oxidation of Thiosulphate

The oxidation of thiosulphate by nitric acid presents fewer problems than those encountered in the oxidation of thiocyanate by nitric acid.

On acidification by nitric acid, the unstable free thiosulphuric acid is formed, which then breaks down to form sulphurous acid and free sulphur. The sulphurous acid is then oxidised to sulphuric acid, and the colloidal sulphur is also oxidised by the nitric acid to sulphuric acid. If a relatively strong solution of thiosulphate is oxidised, with an O/A figure of 1,000 parts per 100,000, sufficient sulphur is liberated in the colloidal form to conglomerate into small lumps on boiling. These are more resistant to oxidation, presenting, as they do, a relatively small surface area for the weight of sulphur involved.

The O/A value of thiosulphate solutions is greatly reduced after treatment with nitric acid. A solution initially of 1,000 parts per 100,000 has its O/A value reduced to 14 parts per 100,000 after 30 min. reaction with nitric acid. Similarly, in the presence of 1.5% W/V ammonium chloride, the final O/A figure after 30 min. boiling is five parts per 100,000.

In an inert atmosphere of nitrogen, the final solution after 30 min. boiling had a somewhat higher O/A value than when performed in the presence of air. In fact, after 30 min. oxidation with nitric acid, the solution had a residual O/A value of 40 and 60 parts per 100,000, dependent, respectively, on the presence and absence of ammonium chloride.

Nitrous acid is not so active as nitric acid for oxidising thiosulphate, and the results are relatively disappointing. The final solution after 30 min. boiling had its O/A value reduced from 1,000 to 120 parts per 100,000.

The following table shows the extent of destruction of thiocyanate and thiosulphate in solution, in a 30 min. test. The original O/A of the test solution was 1,000 parts per 100,000; the table shows the final O/A values:—

		NH_4Cl Absent	NH_4Cl Present
'SCN	HNO_3 in Air	6	4
"S_2O_3	" " "	14	5
'SCN	HNO_3 in N_2	16	12
"S_2O_3	" " "	60	40

The final O/A figures have no absolute value, and are only comparable with each other.

Oxidation of Phenol

Results obtained when oxidising phenol with nitric acid show that, although phenol will nitrate easily, there is actually very little break down of the basic benzene ring structure.

One of the principal products of nitration is *o*-nitrophenol which is volatile in steam and is found condensing on the cooler parts of the apparatus during the oxidation period. It is, however, probable that *p*-nitrophenol is also formed, and the other polynitro derivatives must also be formed if strong nitric acid is used. Thus, after oxidising a phenol solution of O/A value 1,000 parts per 100,000, the final solution has an O/A value of 774 parts per 100,000. An inert atmosphere of nitrogen has no appreciable effect on the final O/A figure. As before, ammonium chloride has a beneficial effect, the final O/A value being in this case 705 parts per 100,000 after 30 min. boiling.

The effect of oxidising phenol with a nitrous acid solution is very interesting. A much better reduction in O/A value is obtained than when nitric acid is the oxidising agent. A phenol solution initially of 1,000 parts per 100,000, after oxidising with nitrous acid has a residual O/A value of about 360 parts per 100,000.

Karrer[11] says the action of nitrous acid on phenol yields benzoquinone monoxime (*p*-nitrosophenol). No evidence has been found to suggest that benzoquinone monoxime is unstable in water and breaks down into simple aliphatic molecules. Therefore, the inference here is that benzoquinone monoxime has a substantially smaller O/A value than phenol.

Work was also carried out to a limited extent on other phenolic constituents of the normal effluent liquor. One of the most interesting results was that noted in the treatment of resorcinol.

Under laboratory conditions, resorcinol did not respond at all to treatment with pure nitric acid at the appropriate dilution. On the other hand, when using mixed nitric and nitrous acids, there was a prompt fall in the O/A value to slightly under 20%, which prolonged boiling did not affect. Here, again, it is indicated that a stable compound has resulted, and not the destruction of the phenolic molecule. These observations are being followed up.

Cost Calculations

The authors have selected an analysis given in Key's 'Gasworks Effluents and Ammonia'* as being typical of a still effluent. According to col. 4 of table 4 of that work,

		grammes per 100 c.c.
Thiosulphate	as S	= 0.08
Thiocyanate	as CNS	= 0.15
Phenols	as C_6H_5OH	= 0.26

Using the equations given in the summary, the two salts would require altogether 55 lb. of nitric acid (100%) to obtain destruction. At least 90% of the nitric oxide is to be recoverable, so 5.5 lb. represents potential loss.

Allowing 1 mol. of nitric acid per mol. of phenol, the nitration product would absorb 17.5 lb. of nitric acid. The total

* Key, A. 'Gasworks Effluents and Ammonia.' *Inst. Gas Eng. Comm. No.* 188.

of 23 lb. would at the current price of £28 per ton for 70% nitric acid, represent 8s. 3d. per 1,000 gal.

The other major loss of nitric acid that is possible is the unused nitric acid in the treated liquor. In the absence of special measures to remove and recover it, one has to contemplate a loss of 0.16 N., or 101 lb. per 1,000 gal. effluent. This is a critical matter, as the following will show:—

		Per 1,000 gal. effluent
Loss:	0.16 N.	costs 36s.
	0.08 N.	,, 18s.
	0.02 N.	,, 4s. 6d.

If means were taken to reduce the residual nitric acid and to recover the gases, the lower figure is found to be achievable, but the authors are not able to assess the processing cost, which should be small.

There has been indicated the possibility of producing the nitrogen oxides on the plant by the ammonia oxidation process. In actual fact there is reason to examine this matter further. The consistent production of ammonia as gas, or as a strong aqueous solution, with the necessary safeguards for its purity, requires good equipment and practice, and for the present purpose the authors would tend to rely on the material available from established producers. The current price (August, 1951) of liquor ammonia (25%), including a moderate carriage cost, would be equal to £42 10s. per ton of pure ammonia, and the cost of 100% nitric acid after conversion appears low (£11 10s. per ton; say, £15 to £20 in all).

Hence, on these terms the charges cited above might be reduced by one half or even more.

The authors have only rather vague ideas on the capital costs of the complete treatment unit, but with such guidance as is available on the extent of acid-proof plant for production of nitric acid, they are reasonably sure that a total capital charge of 5s. per 1,000 gal. will not be exceeded on the scale of treating 500 to 1,000 gal. per hour of effluent.

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DISCUSSION

Dr. W. H. Blackburn (Gas Research Board) said that some indication of the changed outlook of the gas industry towards its effluent problem was given by the fact that the authors had brought to their notice a method of effluent treatment which would certainly involve a considerable expense. It was, however, becoming increasingly recognised that the effluent problem was one which had to be faced and, bearing in mind that the total cost of treatment at gasworks and sewage works should be as low as possible, there were circumstances in which it might be necessary to incur somewhat heavy costs at the gasworks.

The essential idea in the paper was to destroy the thiocyanate in gas liquor by oxidising it with nitric acid. Those who were specially interested in effluent treatment had considered oxidation by chemicals, but up to now had neglected them on the grounds of cost. Even chlorine, which was the cheapest of them all, seemed to be too expensive save in exceptional circumstances, and, moreover, could probably only be used after a liquor had been dephenolated. When he first heard of this proposal to use nitric acid, therefore, he thought it must be too expensive, until he learned that the authors planned to recover and re-use a large proportion of the nitric acid. It was this fact which seemed to bring it within the realms of practical politics. Unfortunately, nitric acid was used up by side reactions, and he noticed that the authors themselves were very concerned about the cost.

Nitric Acid Consumption

The consumption of nitric acid and the consequent expense were important. The calculations for a typical spent liquor were given in the paper. The first item was the amount of nitric acid required to deal with thiocyanate and thiosulphate, which was given as 55 lb. per 1,000 gal. Of this amount, 32.5 lb. was required for the thiocyanate and the balance of 22.5 lb. was presumably required for the thiosulphate. It was not clear, however, how this latter amount was obtained, as the equations referred to by the authors did not include a satisfactory one for thiosulphate. Ninety per cent. of the acid used in the reactions with thiocyanate and thiosulphate was stated to be recoverable and so the net consumption was taken as 5.5 lb. This item was small relative to some of the other items and so the amount used in the oxidation of the thiosulphate was not therefore of great importance.

The second item in assessing the total consumption of nitric acid was the amount required to react with monohydric phenols. Now the monohydric phenols in spent liquor included cresols as well as phenol, but it was customary to express analytical results as C_6H_5OH. One molecule of nitric acid had been allowed for each molecule of phenol as given in the analysis. Several assumptions were involved in this calculation, but the amount of nitric acid allowed for reaction with the monohydric phenols would probably be sufficient. The authors did not, however, make an allowance for any consumption of nitric acid by the dihydric phenols. In their experience a spent liquor obtained from a crude vertical retort liquor contained about the same amount of dihydric phenols as of monohydric phenols.

It was indicated in the paper that resorcinol did not react with nitric acid at the appropriate dilution. No mention was made of catechol, which he would expect would be oxidised to some extent, if not nitrated. Had the authors any experimental evidence that the consumption of acid by the dihydric phenols was negligible? And what about the effect of nitric acid on some of the other constituents of gas liquor, many of them as yet unknown? Even if the consumption of nitric acid in this respect was negligible, the compounds produced might possibly be toxic ones.

The largest item in the assessment of the total nitric acid consumption was, however, that remaining unused in the treated liquor. The cost of this could amount to as much as 36s. per 1,000 gal., but the authors indicated that it should be possible to reduce it to about 4s. 6d. He would be very interested to hear how they proposed to do this.

Implication of Cyanide Content

He understood that the authors had now a pilot plant in operation, and perhaps they would be able to give some experimental figures for the consumption of nitric acid. These would be much more valuable than those based on a number of assumptions. He would also ask the authors if they were keeping careful watch on the cyanide content of the treated liquor leaving the pilot plant. In normal operation the cyanide content of the effluent should be small, but it did seem that it might occasionally be dangerously high. It had to be remembered that cyanide in an effluent was much worse than thiocyanate, particularly in sudden doses.

Consider what happened when a plant such as that shown diagrammatically in the paper was started up. Some of the HCN generated would be dissolved in the water used for irrigating the rings in both towers and returned to the system. There would thus be a gradual increase in the concentration of the HCN in the gaseous phase. Eventually a position of equilibrium would be reached at which the amount of HCN generated would be exactly equal to the HCN leaving in the waste gases. In theory, the HCN was expelled from solution as a result of keeping it at the boiling point, but traces would always be present in the effluent and possibly more than traces on occasions. In a paper referred to by the authors on the manufacture of hydrogen cyanide from sodium thiocyanate, Conroy stated that about 1% of the total HCN production might be lost in this way.

It was obviously too early to ask the authors how much chemical supervision the plant would require. In addition

to operational control, particular care would have to be taken to avoid leaks of the waste gases containing hydrogen cyanide.

The section on the removal of nitrated phenols by active carbon was, as the authors themselves indicated, incomplete and gave rise to a number of questions. First, was it necessary to remove them? Some work by Dr. Wilkinson, of the Water Pollution Research Laboratory, showed that 20 parts per mill. of dinitro-phenol in sewage had no effect on the bacterial population of the film on percolating filters. It seemed possible that the nitrated phenols might be no more objectionable than the phenols from which they were derived. On the other hand, some toxic compounds might be formed whose removal by active carbon or otherwise was essential. Secondly, in practice it had generally been found that the life of active carbon when used for the dephenolation of gas liquor was too short. Was the life of active carbon when removing nitrated phenols, etc., from gas liquor, treated with nitric acid, longer than that obtained in removing phenols from untreated liquor? But even if this was the case, would it not be preferable to remove the phenols by a solvent extraction process before treatment with nitric acid? No doubt these were questions which the authors themselves had very much in mind.

Hot De-tarring

The authors pointed out that at many works it was possible to divide the gas liquor into two portions. First, a relatively small volume of retort house circulating liquor which contained considerable amounts of undesirable constituents such as thiocyanate and higher tar acids. Secondly, a much larger volume of liquor obtained from the condensers and scrubbers which contained much less of the undesirable constituents. This separation of the bad from the good was achieved most successfully by the practice of hot de-tarring. The composition of about 90% of the liquor was such that after distillation for the recovery of free ammonia it could in many cases be admitted to the sewers without further treatment. The disposal of the remaining 10% of the liquor—*i.e.*, the retort house liquor—was, however, not easy, and this fact was an obstacle to the more general adoption of hot electro de-tarring. Sometimes it was possible to persuade local farmers to use it on the land, but this tended to be a seasonal use and it was not altogether satisfactory to be entirely dependent on the goodwill of local farmers. The process suggested by the authors should be of assistance in lessening the objectionable character of retort house liquor. Additional treatment for the removal of the higher tar acids would, however, be desirable before addition to the sewers.

This brought him to his last point, which was that too much reliance must not be placed on O/A values. The authors were well aware of this and themselves specifically made the point. Reduction of O/A might sometimes be the result of changing a compound A which reacted with permanganate in the conditions of the O/A test to another compound B which did not; and compound B might have a very much more serious effect in sewage purification than compound A. He would therefore like to stress that before any such process as that envisaged by the authors was employed on the large scale, some biological experiments should be carried out to determine the effect of the treated liquor in sewage purification.

The process represented an entirely new approach to the gas liquor disposal problem and, as such, they should welcome it, although at the moment it appeared that the cost would be too high for it to be applicable except in special circumstances. The research now in progress would no doubt eventually provide the answers to many of his questions.

The Question of Cost

Mr. C. L. Evans (Brotherton & Co., Ltd., Birmingham) said that the work of Mr. Cooper and his collaborator marked a new departure in trade effluent treatment. An attempt had been made to simulate bacterial oxidation—*i.e.*, oxidation by indirectly employing atmospheric oxygen. Apart from the scientific interest, the process would seem to possess every feature of practical application as an ancillary to a liquor treatment process. The costly fixation of oxides of nitrogen by residual phenol and the necessary carbon absorption treatment to remove an unwanted nitro-body did not appear an economic proposition. This would suggest, therefore, that the process be applied only to dephenolated still liquors. The process, however, provided an answer to the difficult problem of disposal of purifier box drainage and effluents arising from liquid purification processes.

He would like the authors' views on the treatment of settled limed still effluents, arising from treatment by this process. Would not the high pH usually associated with these effluents cause further NO_2 loss and thus preclude treatment by this process?

The authors hoped to present more detailed enquiry into the other reactions that contributed to the observable O/A reduction. It would be interesting to know the composition of the bodies in the effluent forming the residual O/A. Mr. Cooper had stated that they were mostly of an inorganic character. He would like to support Dr. Blackburn's view. If so, were they treatable by sewage bacteria?

The authors intended that 90% of the NO produced by the reaction was to be recovered. Basically, this process of recovery was similar to the chamber acid process from which it was known that NO reacted with O_2 at a relatively slow rate. In effect, it was the limiting factor in the rate of production of acid by that process. From Bodenstain's investigations the velocity of the oxidation of NO was proportional to the O_2 and the square of the NO concentration. Furthermore, the reaction was unusual in that it had a negative temperature coefficient—*i.e.*, a rise in temperature reduced the velocity.

It would seem, therefore, that special consideration should be given to the design of the NO oxidation unit, providing adequate reaction space and gas cooling. He understood—and he had seen this plant—that the use of oxides of nitrogen produced from the oxidation of ammonia had yet to be tried. The recovery system had yet to be tried. As he said, this design should provide adequate reaction space and gas cooling. To effect 90% recovery of oxides of N_2 it might require a much larger unit than was anticipated. Reviewing the figures given in the paper, treatment costs could be prohibitive. If, however, by further development 90% NO recovery could be effected and some means introduced to render unnecessary the high acidity of the treated effluent—and there was a possibility that that might come; it was mentioned in the paper—then there was little doubt that the process, so simple in plant design, would find many applications in trade effluent treatment.

'A Courageous Account'

Mr. Philip Wedgwood (Production Engineer, Watford division, Eastern Gas Board) remarked that the authors had had the courage to give an account of their attack on one part of what was still a problem to which a satisfactory solution must be found in the very near future. He meant by that the settlement of a basis on which charges for effluents might be based which would be fair to industrialists on the one hand and the local authorities on the other. He did not mean that there was any difficult problem to be solved in respect of the satisfactory disposal of gasworks effluents. In too many places the fundamental difficulty did not have its origin in the gasworks, but in the sewage disposal works and therein lay a serious difficulty which they could not solve.

Emphasis was laid on the reduction of the O/A value of the effluent resulting from nitration, the objective being a smaller charge for subsequent treatment of the final products of the process at the sewage disposal works, assuming that the O/A figure would be the basis of charge. In such circumstances, the proposal had attractive features, but was it not just another example of the inadequacy of the oxygen absorption tests as a measure of the organic constituents of an effluent?

The authors had dealt briefly with the question of the possible effects of the nitrated products which remained in the treated effluent. Obviously these must be kept down to the minimum, but in this connection he would mention that some recent research work on the synthesis of carotenoids from glucose by certain types of bacteria had indicated that dinitro-phenol promoted their production. It was interesting also that phenol inhibited the reactions while dihydric phenols were less active, but when iron was present these inhibitory effects were prevented. In fact, he believed that iron played a fundamental part in the sewage purification processes. That might be encouraging to the authors; and following that line of thought he was pleased to note that the conversion of organic substances to something different had received appropriate comment. All too often the term 'oxidation,' when used in reference to reductions in O/A value of the liquids during their passage through a sewage treatment works, was almost if not wholly synonymous with 'disappearance.' Low O/A and B.O.D. figures did not always indicate a high degree of purity of an effluent.

Rightly, the authors had considered the further treatment of these liquors after the removal of ammonia and phenols. Surely it was wrong to approach this subject with the idea of determining how efficiently or inefficiently gasworks products could be destroyed at the sewage works. He knew they could be

destroyed most effectively. He also knew that at some works where there was no gas liquor discharge to the sewers there was thiocyanate in the final effluent, but that was another story.

When he gave a paper in May last year to the Eastern Section at Felixstowe, he made this point about recovery in rather strong terms. He pointed out that from the national aspect they should not be wasted and that a greater need for phenol was likely to arise. He said that while the coal carbonising industry was pouring phenols down the drain, other people were synthesising phenols. He suggested that tar oils would be suitable solvents and that tar distillers were in a position to recover them, and he referred to the Beckton plant which had been at work a long time and operated with good results.

He had seen the plant at Bolsover where phenols were extracted from low temperature carbonisation liquor. He had been impressed not only with what had been done already but with the keenness and enthusiasm with which they had delved into these other matters as a chemical engineering problem. He believed that before many more years had rolled by the processes which took place during the purification of sewage would also be tackled as a chemical engineering problem—a complicated one, to be sure.

Use of Ozone

Mr. J. Foxton (Senior Chemist, Cheltenham sub-division, South Western Gas Board) commented that the authors stated that the effect of their process was to accomplish the conversion of these salts to comparatively harmless substances, by indirectly employing atmospheric oxidation. It was unfortunate for the gas industry that the process could not be direct, so that the large capital expenditure necessary for the erection of complex plants would be rendered unnecessary. To maintain the balanced conditions necessary for the efficient working of the plant, trained personnel would be required, and this would be an additional charge on the process.

Work had been proceeding in the U.S.A. on the oxidation of coke oven effluents by ozone, and figures were quoted showing the reduction of phenols to one part per mill., which was equivalent to an O/A (due to phenol) of 0.18 parts per 100,000. Further details of the process were not yet available. Methods such as this would not involve the large capital costs of the plant described by the authors and less attention would be required.

Work being carried out using nascent oxygen for oxidation had shown in preliminary experiments that the O/A could be reduced from 900 to 600 parts per 100,000. The optimum conditions to reduce this still further had not yet been found, but work was proceeding. In these experiments they found appreciable reductions in the phenol, higher tar acids, and thiosulphate contents. It was logical to assume that reactions such as those suggested by the authors would be anticipated in a process employing ozone or nascent oxygen since the underlying principle in each case was oxidation.

Disposal of effluents to sewage works was not the solution of the problem for the gas industry. Now that gas boards had decided to concentrate manufacture of gas at a number of large efficient works, the inevitable result would be to make a volume of effluent far in excess of that acceptable by the sewage authorities. The position today was that action must be taken, as their hand was being forced by the rivers boards. Had more attention been given to the recommendations of the Effluents Committees some years ago, they would now have been much nearer a solution. It was unfortunate that gas engineers were so conservative, especially where new chemical processes were concerned. To obtain the future standards that would be required by the rivers boards, oxidation carried out by the simplest efficient process, with low capital cost, should be the most promising and acceptable solution of their difficulties.

Reply to Discussion

Mr. Cooper, replying to the discussion, said that Dr. Blackburn had rightly pointed out that the overall cost of working liquor in this way was made up of two major items, one of which was the phenol content, which absorbed nitric acid, which was not returnable, and the other was the residual acidity figure which appeared necessary to make the other reactions go. Either could be minimised. The true process of improving the effluent liquor should include the recovery of all those substances, if at all possible; and that would work on some scale which they could not determine at the moment, but he was sure not on the smallest scale.

The second point was about the thiosulphate reaction. He would expect to find that the reaction of the thiosulphate was also sensitive to the final concentration of nitric acid. In other words, it would probably go at one concentration of nitric acid and would go very well below a certain limit. The more complex phenols would absorb less nitric acid than the monohydric phenols. It could be treated roughly as a proportion of normality of acid in solution. In the pilot plant it balanced reasonably well. They agreed near enough with the monohydric phenol nitration. Concerning the nitrous acid, if they got nitrous acid to form in the absence of nitric acid, he thought the limit would disappear.

They could look for traces of hydrogen cyanide, and would report them if they found them. In any case, it could only be a fraction of what was entering in the CN group in one form or another.

Mr. Evans asked for views on settled limed still effluents. There was a surplus of sulphuric acid in the proportion of the thiocyanate, even if they ignored the nitric acid; and the limed effluent therefore would help to destroy the excess acidity produced by the oxidation of sulphur. If too much lime was present the reaction would necessarily stop.

In regard to the use of ozone for similar oxidation treatment of phenols, he had seen this reference and they had worked out the cost of the process as carried out in this country as £4 per 1,000 gal.—and that was applying it to coke oven liquor and not to heavy liquor such as that to which they were accustomed here.

MECHANICAL TESTS FOR METALS

THE strength of materials of construction and probable behaviour of these materials under load has been the concern of designers for very many years. The formulation of suitable tests by which the quality of metal products could be assessed without having recourse to full scale testing was undertaken by the British Standards Institution as one of its earliest tasks. This resulted in the adoption of a series of standard tensile test pieces. Since that time, a number of British Standards have been issued which deal with different types of mechanical tests and a number of other standards include requirements for specific applications of these tests.

The standards that deal solely with mechanical testing, together with extracts from other standards to illustrate particular applications of the tests, have been collected under one cover to form a new Handbook, and so provide a reference book useful to industry and to universities and technical colleges where the subject of strength of materials is taught.

The development of standard methods of test and their importance in the field of mechanical testing are reviewed in an introduction contributed by Dr. H. J. Gough, F.R.S., who is a member of the Mechanical Engineering Industry Standards' Committee and was for many years closely connected with the work, being for some time Chairman of the committees concerned.

The Handbook has been arranged in sections which deal with types of tests. Seven sections cover tensile tests, hardness tests, impact tests, ductility tests, the transverse tests for cast iron, and the verification of tensile and compression testing machines. Each section quotes in full the British Standards for the type of test being dealt with, and continues with suitable extracts from other Standards, where such exist, which illustrate particular applications of the test. The section dealing with tests on thin metal departs from this principle by quoting the whole of a Standard which deals comprehensively with the tensile, bend hardness, and ductility tests for thin metal sheet and strip material.

The final section embodies a comprehensive series of conversion factors and conversion tables, which include values of stresses and moments of inertia converted from inch-pound units to metric units and *vice versa.*

Copies of this Handbook may be obtained from the British Standards Institution, Sales Department, 24, Victoria Street London, S.W.1; price 17s. 6d. net, post free.

PURE SULPHUR FROM SPENT OXIDE

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Paper to the Research Meeting of the Institution of Gas Engineers. (I.G.E. Publication No. 197)

THE recovery of elemental sulphur from spent oxide has for many years been contemplated by the gas industry. Extraction by carbon disulphide is a well-known process, which is operated on a limited scale both in this country and in Germany; its cost has been fully discussed[1], [2], [3].

The inflammability, volatility, and toxicity of carbon disulphide are such that the most stringent precautions must be taken where it is used. The rate of extraction of sulphur from spent oxide by carbon disulphide varies greatly, the factors governing the rate being largely unknown. The extract solution contains most of the tarry impurities originally present in the spent oxide. No commercial physical process has yet been developed by which sulphur of low tar content may be produced from this tarry solution. The sulphur may, however, be freed from tar by treatment with oleum. This chemical process, which consumes valuable acid and presents a problem in the disposal of spent acid, has not been considered attractive by the gas industry.

In the Fulham Laboratory of the former Gas Light and Coke Company, renewed attention was given in 1945 to other solvents, particularly the aromatic hydrocarbons, which may be used to extract the sulphur at an elevated temperature. Because of the high temperature coefficient of solubility, the sulphur may be crystallised from these solvents by cooling, a method impracticable where carbon disulphide is used. In the crystallisation process a large proportion of the tar remains in the mother liquor, but the sulphur crystals are not pure enough to make further treatment unnecessary unless the spent oxide be very low in tar, as is often the case in coke oven practice.

Reliable data for the solubility of sulphur in the aromatic hydrocarbons were not readily available, particularly at temperatures near the boiling-point of the solvent. Table 1 shows results obtained by Dr. R. H. Griffith, in 1945. They apply closely for any of the three solvents benzene, toluene, and xylene.

TABLE 1.—*Solubilities of Sulphur in Benzene, Toluene, or Xylene, in Grammes per Litre; Solvent Volume Measured at 20° C.*

Temperature (° C.)	Solubility (grammes per litre)
20	10
30	16
40	25
50	39
60	56
70	83
80	118
90	163
100	222

Toluene was selected as the most convenient solvent. It is readily available, and the extraction can be carried out at relatively high temperatures without the use of elevated pressures. Many proposals have been made for the use of aromatic solvents for sulphur recovery. Bécigneul, in 1904, was the first to mention toluene[4]. German companies have proposed the use of benzole under pressure[5], [6]. Weil has described the use of xylene[7].

The limited amount of work possible in the Fulham Laboratory during the period 1945 to 1948 failed to establish a basis for a practical process for producing tar-free sulphur from spent oxide. Further experiments on extraction by toluene were then carried out by Dent and Moignard[8], who obtained, from gasworks spent oxide containing 3.5% tar, sulphur containing as little as 0.5% of tar, but not sufficiently pure for direct use in the simplest type of contact sulphuric acid plant.

In spite of these observations, it was felt that further work on the toluene method should be carried out in an attempt to obtain sulphur crystals with a much lower tar content. The experiments reported here were therefore begun in 1950.

Crystallisation Process

In approaching the problem of the crystallisation stage, it was necessary to consider how the tar is held in the crystal. Its presence was thought to arise in one or more of three ways:—

(1) Adsorption of tar on the surface of the sulphur crystals.

(2) The trapping of mother liquor during crystal formation (*e.g.*, by the type of branch-like development termed dendritic growth)[9].

(3) Occlusion of mother liquor, caused by solid impurities falling upon the surface of the growing crystal. These particles prevent growth on the areas which they cover, until eventually normal growth from the surrounding area forms a bridge over the impurity and leaves a pocket of mother liquor within the crystal.

Of these, the third may be caused by particles of oxide or free carbon in the solution, and may be eliminated by filtration of the hot toluene extract before crystallisation.

In cases of adsorption, it is normally possible to remove the adsorbed material by washing with a suitable solvent, for which purpose clean toluene, or a saturated solution of pure sulphur in toluene, should be adequate. No improvement in the purity of the sulphur was effected by washing with cold toluene, and it was concluded that adsorption plays no major part in the process.

The second possibility therefore remains, and this is the most difficult both to detect and to prevent. It is known that dendritic growth may arise as a result of concentration differences in the solution around the growing crystal, and that it is also possible for a crystal of normal form to possess a dendritic inner structure which has subsequently been filled in by normal growth, so that mother liquor may be enclosed in this way within the crystal during its growth when agitation of the crystallising solution is not adequate.

Work was therefore directed towards the elimination of concentration differences in the toluene solution during the crystallisation process. When the toluene extract of spent oxide was allowed to crystallise both with and without vigorous agitation, it was found that those crystals formed with agitation were considerably lighter in colour. A series of experiments was carried out to find the conditions needed for the formation of sulphur crystals of the required standard of purity.

Method of Analysis

At the time when this work was started, sulphur could be sold at a good price only if it met the requirements of sulphuric acid manufacturers using the simplest type of contact plant. The standard of purity demanded seemed to vary greatly, but it was clear that if the tar content of the sulphur could be reduced below 0.1% most users would be satisfied.

For tar contents up to 0.1% the most convenient method of analysis involves just melting about 1 gramme of the sulphur in a crucible and lighting it with a small flame. The molten sulphur is allowed to burn without further heating until the flame goes out; the residue is then weighed. The weight of the unburnt portion is related to the proportion of tar in the original sample, and the percentage of tar may be estimated from a graph obtained by tests on synthetic mixtures of

pure sulphur with tar of the same type. Sulphur containing more than 1.0% of tar will not remain alight when treated in this way. The simple crucible test was found to give results in good agreement with the method used for the higher tar concentrations, in which the sample is burnt in oxygen at 950°C. and the tar estimated by measuring the carbon dioxide formed.

Residual Toluene in the Crystals

When the sulphur crystals from the earlier experiments were dried in air at 100°C., and then analysed by the simple crucible method, the tar content was found to be lower than was indicated by the high temperature combustion method, and the results were not reproducible.

On grinding these crystals, the presence of toluene was made quite clear by its odour. This residual toluene may be removed by melting the sulphur and heating the melt to about 120°C. The loss in weight on fusion varied from about 0.2% for crystals obtained from a well-stirred solution to about 0.5% when there was no stirring. In subsequent work, the crystals were always fused in this way. The solidified melt was regarded as the final product. It could be analysed without difficulty or lack of reproducibility.

Crystallisation of Pure Sulphur

When difficulties with the analytical method had been overcome, the experiments on the conditions of crystallisation soon showed that sulphur of satisfactory purity could be obtained by crystallisation followed by fusion. The solution had to be stirred rapidly during crystallisation, and the rate of cooling maintained at or below 25°C. per hour. Even under these conditions the crystals were not uniform in colour, those formed at lower temperatures being considerably darker than those separating initially, so that by separating the crystals obtained above 40°C. a further improvement in quality was obtained. The purity of the sulphur obtained by various methods is compared in Table 2. It is believed that in the fusion of the sulphur at 120°C. not only the toluene, but also some of the lighter fractions of the tar, are removed. The product, which was conveniently obtained in the cast form, is of good colour.

TABLE 2.—*Effect of Conditions of Crystallisation on the Purity of Sulphur Extracted from Dried Spent Oxide by Toluene.*

Method of Crystallisation	Tar in Product %
(1) Rapid cooling without stirring	0·3
(2) Slow cooling with stirring	0·07
(3) As (2), crystallisation above 40° C.... ...	0·03

Tar content of spent oxide = 1·2%.
Sulphur content of spent oxide = 49·2%.

By limiting the crystallisation to temperatures above 40°C., it was possible to obtain sulphur of the desired standard from spent oxide containing nearly 4% of tar.

The extraction stage of the laboratory experiments was carried out first at 98°C., later at 105°C., using dried oxide in all cases. The higher temperature gives much more rapid and complete extraction of the sulphur. It may be noted that an extraction temperature between the boiling-points of water and toluene permits the extracted oxide to be steamed free from residual toluene without change of temperature. There is then little condensation of steam, leaving the oxide reasonably dry. This extraction temperature is below the melting-point of sulphur. There is little danger of the fractional crystallisation being spoilt by the separation of the extract solution into two layers.

Drying is essential because it is difficult to heat moist oxide above 84°C., the temperature of the constant boiling-point mixture of water and toluene.

The Production Process

The laboratory experiments described above formed the basis for a process which could provide, from ordinary gasworks spent oxide, sulphur suitable for burning in the simplest type of contact sulphuric acid plant. The process includes the following stages:—

(1) Drying the oxide.
(2) Extraction of the dried oxide with toluene at not less than 100°C.
(3) Crystallisation by slow cooling at a rate not greater than 25°C. per hour and with continuous agitation. The crystallisation should be limited to temperatures above 40°C., unless the tar content of the extract solution is fairly low (*e.g.*, 1% of the sulphur content).

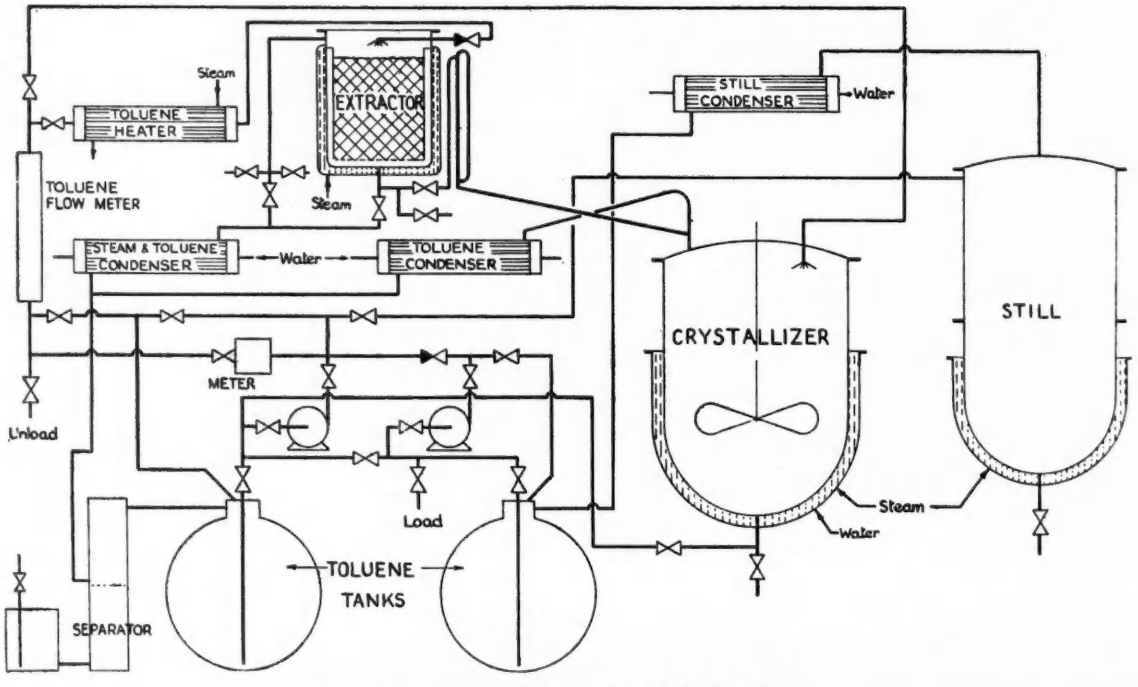

Fig. 1.—A Simplified Flow Diagram of the Pilot Plant.

(4) Fusion of the drained and washed crystals, with heating to 120°C. to remove all toluene and volatile organic matter.

It was decided that a pilot plant should be constructed to study the process on a larger scale. The principles outlined are the subject of a patent application[10].

The Pilot Plant

The plant is represented in Fig. 1 by a simplified flow diagram. The design is for batch operation of each stage of the process; these stages are as follows:—

(1) The oxide is dried in apparatus separate from the extraction plant. A batch of about 150 lb. of the dried oxide is brought to the plant in a cylindrical container with a filter-cloth base.

(2) The 'basket' of oxide is fitted into the extractor, which is an enclosed mild steel vessel heated by a steam jacket to 105°C. and thermally insulated. The extractor is purged with nitrogen to remove the air.

(3) Toluene vapour is then passed into the extractor; it condenses on the oxide and heats it to the required temperature of 105°C.

(4) Liquid toluene at 105°C. is then passed into the extractor. This is so arranged that the oxide charge is covered with toluene, which flows down through the charge. The sulphur solution passes through the filter cloth and away from the extractor by an overflow seal to the crystalliser. When the desired volume of solvent has been passed, the oxide is drained, either by gravity to the separator through the steam and toluene condenser, or by nitrogen pressure to the crystalliser.

(5) Crystallisation is effected in a cast iron vessel enamelled inside, steam-jacketed outside, and fitted with a stirrer. It is heated at 105°C. while receiving the extract solution. When the total of about 60 gal. of solution from one batch of oxide has been collected, the steam to the jacket is turned off, the stirrer is started, and cooling water is passed through the jacket at a controlled temperature.

(6) When the desired minimum crystallisation temperature is reached, the cooling water is turned off, the stirring is stopped, and the mother liquor is pumped from the crystals, which are retained by a gauze filter. The crystals are washed with cold toluene, which is quickly pumped away. The crystalliser jacket is again heated with steam to melt the sulphur crystals and raise the melt to 120°C., so that all toluene is distilled off. The melt, about 65 lb. of sulphur, is run off from the crystalliser vessel through a steam-jacketed cock into a special receiver.

(7) During the crystallisation period, the sulphur-free oxide in the extractor is treated with direct steam to remove residual toluene, the steam and toluene vapour passing to a condenser and thence to the separator.

(8) After steaming, the oxide is removed and replaced by the next batch for extraction, the extractor being again purged.

(9) During the extraction of the next batch, part of the mother liquor and washings may be distilled to recover toluene. The residue from the distillation is a mixture of tar and sulphur, which is discharged through the jacketed cock at the base of still. This residue may, for example, be 5 lb. of tar and 7 lb. of sulphur per batch.

Toluene is stored in two 120 gal. tanks and moved to and from the process units by two rotary pumps. One tank and the pump above it are reserved for clean toluene, the other tank and pump being used for toluene solutions containing tar and sulphur. Pre-set quantities of toluene may be delivered through the Brodie-Kent meter, and the flow-rate is indicated by the rotameter.

An atmosphere of nitrogen at a pressure of 2 in. W.G. is maintained in all the toluene vessels, each of which has an unobstructed connection to a small nitrogen holder outside the plant building.

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DISCUSSION

Dr. L. Moignard (Gas Research Board) said that the high temperature coefficient of solubility of sulphur in toluene was an important reason for advocating its use on account of the possibility that pure sulphur would crystallise when a hot tarry solution was cooled. The authors had successfully concentrated on the procedure required to secure this advantage in practice, and were to be congratulated on following up so effectively the indications of the literature on crystallisation. It was an important step forward.

There were, continued Dr. Moignard, many features of interest in the operation of the small pilot plant. It followed from the properties of toluene already mentioned that one might hope to treat more than one portion of oxide with the same batch of toluene without distillation, up to a limit of tar concentration which might be quite high. The authors had not yet fully explored this, but it was evident that the higher the tar concentration in the oxide used the more frequently would it be necessary to redistil toluene. This involved rejection of the sulphur dissolved in the redistilled portion, which in the instance given amounted to 7 lb., or about 9% of the sulphur in the oxide. As the authors appreciated, this was a reason for extending their purification technique to as low a temperature as possible, but one might emphasise here the point that it was also a reason for seeing that the tar concentration in the oxide was minimised.

It was necessary to compromise between slow extraction with a minimum volume of solvent (to reduce distillation costs) and rapid extraction with a large volume, to raise the oxide throughput of the plant. Data in the report indicated that half saturation overall was obtained, and it would probably be difficult to improve on this in a single extractor. It would be interesting to know how long this extraction took, and in particular whether this, or the time necessary for crystallisation—almost three hours—was the limiting factor governing oxide throughput.

It is true that, with carbon disulphide, oxides varied in ease of extraction, and it might well be so with toluene also. It was in respect of the last two or three per cent. of sulphur that this property was significant, in prolonging for many hours a complete extraction of the sulphur. With re-use of the oxide, however, on which the economics of a process largely depended, it did not matter if sulphur was left in the oxide as long as it did not prove troublesome at the steaming stage.

The authors would now have at their disposal a quantity of extracted oxide—not enough, to be sure, to try it in a purifier, but it might be adequate for a pilot unit. It would be interesting to know whether there had been any tests of the indications of the Gas Research Board work at Poole that the activity of some extracted oxides at least could be high.

Comparison With Carbon Bisulphide

The authors dismissed carbon bisulphide quite briefly, but one might still take a more open view. Calculation showed that the quantities of heat required to distil the solvent for a given quantity of sulphur, from 20°C. to the boiling point for carbon bisulphide, and from 40°C. for toluene, were as 1 to 2¼ in favour of carbon bisulphide. This was, of course, reduced in proportion as the toluene was recycled without distillation, but in practice the main steam consumption was likely to be in removing the solvent from the residual oxide. There was no particular reason why the balance here should favour toluene. An indisputable advantage of toluene was that solvent losses were likely to be easier to minimise. Even accepting the tar problem at its face value, one had to balance

the loss of sulphur in redistilled toluene against the cost of oleum or other treatments if carbon bisulphide was used.

Looking at it more broadly, he did not think that they should be content to regard the tar problem quite in that way. It would be unfortunate if the very success of this work were allowed to create the impression that no harm was done if tar was permitted to accumulate in oxide since it could be dealt with in extraction. Their experiments had shown that it undoubtedly paid to remove as much tar as possible from the gas, and, for example, by washing with oil at a rate of ¼ to ½ gal. per 1,000 cu.ft. of gas, the development of back pressure had been virtually eliminated. By this means, too, they had already obtained, when purifying vertical retort gas, spent oxide containing ½% of tar, corresponding to 1% in the sulphur, a figure which they might be able to reduce as the system cleaned up. As the authors indicated, coke oven practice could result in an almost tar-free extracted sulphur.

While it was agreed that at present the acid manufacturers demanded the highest standard of purity, he asked whether the authors were convinced that such a standard was really necessary. During the war sulphur containing 4% of bitumen was successfully used, and slight modifications of the burners would enable a substantially purer sulphur to be consumed without difficulty.

Question of Economics

Dr. J. G. King, O.B.E. (Director of the Gas Research Board) remarked that the basic discovery in this work would seem to be that sulphur crystals of sufficiently high purity were obtained if crystallisation was achieved under a condition of rapid stirring and slow cooling to a minimum temperature of 40°C., with subsequent fusion of the crystals to remove the entrained solvent.

Dr. Burden had explained that this was in the nature of an interim report, and no doubt many points about the development of his ideas were in his mind and the mind of his co-author. Before this proposal was examined on a larger scale, it would seem wise to give careful consideration to what might happen to the circulating solvent in which the tar would build up, and how the cost of purification of this solvent (presumably by frequent distillation, as in Fig. 1) would affect the cost of any industrial process based on the research work. If a process of extraction of sulphur was to be successful it was important that the extracted oxide could be re-used for gas purification. Dr. Burden had made the point, but he did not say what effect their method of extraction had upon reactivity.

There were obvious reasons why it would be better for the gas industry to give the sulphuric acid industry a clean sulphur rather than a material like spent oxide, but it was readily calculable that no solvent extraction process could be economic unless the extracted oxide could be re-circulated at least three or four times through the boxes.

He thought most people would agree, following the point made by Dr. Moignard, that the best picture to visualise for the future was the arrangement in new gasworks of the sequence of gas purification so as to achieve the removal of tar fog before the gas was purified from hydrogen sulphide. It had been established in Dr. Moignard's work that benzole removal, or, at least a minimum wash with oil to remove naphthalene, followed by electrostatic precipitation, would give a spent oxide from which simple extraction would yield a sulphur which had a purity of over 99.9%. Further, it had been shown that, if the boxes were controlled in the manner described in GRB 52, the oxide would remain reactive and would be suitable for re-charging to the boxes for as many times as its ferrocyanide content remained below, say, 5%.

A Self-contained System

He felt that this was the direction in which research on sulphur recovery using iron oxide should be prosecuted—namely, a fluid system giving tar-free oxide, recovery of sulphur by solvent extraction or other suitable means, and re-circulation of active oxide. A self-contained system could well be made suitable even for small works.

Until this came about, and should it be considered desirable in the meantime to extract tarry oxides—say, in works where re-arrangement of the purifying sequence was not feasible—the authors' method might well prove technically suitable. A more simple method would be to precipitate the tar from the sulphur solution and, one such method, which had been suggested by Dr. Moignard, was indicated in the last annual report of the Gas Research Board. This was that anhydrous ferric chloride would form a loose compound with tar or hydrocarbon polymers which was granular in form and readily filtrable. Simple filtration, which was an inexpensive operation, would, by removing all the tar, be greatly preferable to the expensive continued re-distillation which was postulated in the author's method. He suggested that this proposal was probably more worthy of research development than one based on redistillation only. On the other hand the authors had found an answer to a problem the solution of which had so far eluded chemists.

Plant on a Large Scale

Mr. R. J. S. Thompson (Continental representative of W. C. Holmes & Co., Ltd.) commented that the recovery of sulphur from spent oxide was an old problem and certain practical processes had been worked out. The proposal to use toluene was not new. The present paper, however, gave further particulars which might make the process a practical one. The authors mentioned that plants were in operation 'on a limited scale' using carbon bisulphide as a solvent, both in England and Germany, and stated the objections to this process. It was not quite correct to use the term 'on a limited scale,' in reference to this process. In actual fact it was in operation on an extensive scale.

One of the oldest plants was at Thyssen's works where the oxide from the purification of 60 mill. cu.ft. of gas daily was extracted with carbon bisulphide for the production of crude sulphur. Ruhrgas had two plants in operation. One produced 1,000 tons of pure sulphur per month and the other produced half this quantity of crude sulphur.

At Reichswerke, Salzgitter, there was a plant for producing pure sulphur from the spent oxide resulting from the carbonisation of no less than 10,000 tons of coal per day from eight batteries. At present only one battery was in operation, but as many as six batteries had actually been in operation. In addition there were at least two other works extracting spent oxide with carbon bisulphide in Germany.

All these plants had been working many years with complete success and without difficulty. He had personally visited most of them many times, often unexpectedly, and could confirm that they worked smoothly and successfully.

The inflammability, volatility, and toxicity of carbon bisulphide were stressed by the authors, but it should be remembered that toluene was also inflammable and volatile and toxic and that it was proposed to use it for extraction at a high temperature which increased its volatility. Full precautions would have to be taken against leakage of liquid and vapour and against fire when using toluene just as with carbon bisulphide, and those precautions would have to be no less stringent with toluene. In both cases the plant would have to be tight against leakage, and if it was tight against toluene then it would be tight against carbon bisulphide.

Anyone who had visited carbon bisulphide plants on many occasions, as he had done, would confirm that leakage of vapour or liquid on these plants was negligible. Indeed, an advantage of carbon bisulphide was its pungent odour, which revealed the presence of the slightest leaks immediately.

It might, moreover, be claimed that carbon bisulphide had the advantage that it was heavier than water. In the event of a fire, the carbon bisulphide could be smothered by water, which floated on the carbon bisulphide. Also, as in the case of the Ruhrgas plant, the extraction plants could stand over a floor flooded permanently with water. Any carbon bisulphide which should spill for any reason whatever was, therefore, immediately immersed in water, and rendered harmless. The buildings could be fitted with water sprinklers which caused no additional dangers. The same could not be said for a plant using toluene as a solvent, the spillage of which would actually present a greater danger than the spillage of carbon bisulphide in a properly designed plant, owing to the fact that toluene floated on water.

The inflammability and volatility of carbon bisulphide could not, therefore, be represented as a serious disadvantage as compared with toluene, although their importance should not be underrated and proper precautions should be taken. The objection that oleum must be used in producing pure sulphur with the carbon bisulphide process was a valid one, but it must be considered in relation to the overall efficiency of recovery of sulphur.

In the process using toluene there was a reject which was a mixture of tar and sulphur. From the figures quoted, the sulphur lost in this reject amounted to about 7 lb. per 'batch' of 150 lb. of spent oxide, or something like 10% of the sulphur available in the spent oxide. This was a very substantial loss, and far exceeded the sulphur in the oleum required for purifying the carbon bisulphide extract in the alternative process. It would therefore appear that the sulphur efficiency of the carbon bisulphide process was very much better than that of the toluene process, account being taken of the oleum consumption; and, therefore, this objection fell to the ground completely.

It had been objected that the disposal of the acid tar from the oleum wash was difficult. This problem existed at all oil and benzole refineries. Could the authors say how the mixture of tar and sulphur from the toluene process would be disposed of? Presumably it would have to be dumped in the same way as the acid tar, unless some additional process of treatment was installed or unless the authors proposed to dump considerable quantities of free sulphur into the tar well, assuming the plant to be located at a gasworks. From the data given in the paper, the quantity to be disposed of was not small and seemed to be considerably more than the acid tar from the carbon bisulphide process. It was difficult to see, therefore, what advantages the toluene process really had, or could possibly have, over the well-established, well-tried, and completely successful carbon bisulphide process.

It might be that when cost data were available, the toluene process would prove to be cheaper in first cost or operating cost or both, in which case it would deserve to be adopted in place of the carbon bisulphide process. It should be kept in mind, however, that the extraction plant represented only a part of the cost of the whole process. The cost of installation and operation of the oxide handling plant was a very substantial proportion of the total cost and would be exactly the same for any process.

Handling of Spent Oxide

If a central works was established for oxide treatment the spent oxide had to be received, emptied, and stocked. It had to be loaded to the washing plant and then transferred to driers and dried. Then it had to be loaded into containers for extraction. After extraction the regenerated oxide had to be emptied from the containers and stocked again. It had to be remixed with suitable ingredients (sawdust, soda, new oxide) probably under cover, and stocked up again and dispatched to the original supplier for re-use. All this handling must be completely mechanised, which involved substantial capital cost and which itself set a minimum limit to the size of plant which was economical. All this handling was common either to a toluene or a carbon bisulphide plant.

The present situation really was that with sulphur prices which had ruled to date extraction plants were on the border line so far as profit making was concerned. Local conditions would decide the exact economies, and it was suggested that this was the main reason why such plants had not gained much favour in England as yet. In Germany they had been built and operated because of Germany's lack of home produced sulphur and her isolation from sulphur markets, from whatever cause. The plants had usually operated at a loss.

If the differential price between spent oxide and pure sulphur became great enough, there was no reason why standard extraction plants on well tried and successful lines should not be built in England immediately. Accurate plant and operating cost data were known, and several plants by different makers could be seen in operation on full scale.

Mr. Newling, replying briefly, said they did not deprecate in any way the use of carbon bisulphide for the extraction of coke oven oxide which was low in tar. The process they had described was confined to tarry oxides from gasworks. Certain questions had been asked about toluene. There was one about the re-use of the solvent and about the build-up of tar in the re-used solvent. In his opinion, subject to confirmation by the works, the steam cost of re-distillation had been overemphasised and it might prove to be right to apply all heat available to the process in the re-distillation of another liquid and to recover the heat by using the toluene vapour.

Another question was the activity of the extracted oxide. If it had been properly treated in the purifiers it would probably be more active than the original and certainly would have more iron content. In regard to the rejection of a considerable proportion of the sulphur with the tar, it would probably be necessary to use secondary crystallisation processes to recover part of that in a form that can be re-cycled. They might be able to reduce the sulphur rejectable with the tar. They had not yet accumulated sufficient of this reject material to determine its physical properties and they were not in a position to consider how it should be disposed of.

On the accumulation of blue in the oxide, this was the only real cause for loss of activity between the first use of the oxide and the second use after extraction. They themselves were not interested in the extraction of blue. The market was such that they could readily sell oxide of high blue content.

Although the process described was for tarry oxides, they would not encourage the production of more tarry oxides or the diversion of most of the extraction plant by those concerned with processes such as burning and chamber acid plant.

JUNIOR ASSOCIATION ACTIVITIES

NORTHERN

A meeting of the Northern Junior Gas Association was held at the Three Tuns Hotel, Durham, on December 7, 1951. The President's Prize, which is given annually for the best short paper, was awarded to Mr. D. P. Dalby, of the Blyth Division of the Northern Gas Board, for his paper on 'The Inspection and Care of Gasholders.' The second prize was awarded to Mr. P. G. Heslop, of the Newcastle Division of the Northern Gas Board, for his paper on 'The Development of the Modern High Efficiency Gas Cooker.'

WESTERN

The Silver Jubilee meeting of the Western Junior Gas Association was held at Bath on December 8, 1951, when some 95 members were present. Members visiting the works displayed much interest in the garage and transport equipment, new boiler plant, water softening plant and new prestressed concrete purifiers. Following tea the members assembled to hear a paper entitled 'Transport' read by Mr. A. G. Thorne, of Bath. This was followed by an Anniversary Dinner at Fortt's Restaurant, at which Mr. T. W. Clapham (Bristol), presided.

Among the guests were Mr. J. H. Dyde, President of the Institution of Gas Engineers and a past President of the Association; Dr. W. T. K. Braunholtz, O.B.E., Secretary of the Institution of Gas Engineers; Mr. C. H. Chester, O.B.E., Chairman of the South Western Gas Board; Mr. J. H. Lowther, President of the Western Section, Institution of Gas Engineers, and Mr. C. P. Bateman, Manager of the Bath sub-division, who is the Founder President of the Association. The Association was fortunate in that only one past President, Mr. S Hole, had died, and all the remainder were able to attend the dinner.

British Standard for Symbols, Terms and Definitions for Gas Quantities in Reciprocating Internal Combustion Engines (B.S. 1798: 1951) was prepared at the request of the British International Combustion-Engine Research Association because the exchange of information relating to the gas processes in compression-ignition engines has been hindered by the lack of clear definition of such terms as 'volumetric efficiency,' 'delivery ratio,' 'scavenging efficiency' and the like. According to circumstances, various means are commonly assigned to such expressions and it is considered undesirable to restrict their use by standardising single meanings. The difficulty can be overcome by the adoption of a standard method of defining the intended meaning. In this standard, symbols, terms, and definitions are given for the simple quantities from which such functions as the above are derived. By means of the symbols, commonly used expressions can be clearly defined. Moreover, many other relationships which may come under consideration can be simply expressed, whereas the allocation of names to them all is impracticable. Copies of the standard may be obtained from the British Standards Institution, Sales Department, 24, Victoria Street, London, S.W.1; price, 1s. 6d. post free.

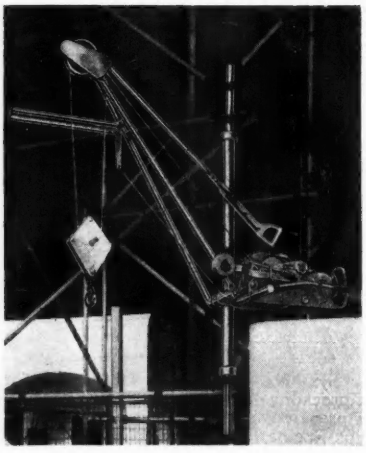
TRADE NEWS

W. E. Bray & Co., Ltd.

New hydraulically-operated dozing equipment fitted to the Fordson Major tractor.

A.C.E. Machinery

The Midget winch and scaffold jib has many applications on all types of building construction. Providing for a 5 cwt. lifting capacity with a maximum jib radius of 5 ft. a good working clearance from the scaffolding is afforded and all normal loads can be speedily hoisted to the working level. The winch and jib are easily set up to the existing scaffold by two men and the winch for independent duty can be instantaneously detached from the jib.



A notable feature is an automatic limit which safeguards against any chance of the operator overwinding preventing the possibility of shock damage or strain to the jib assembly and scaffolding. The winch incorporates a three speed drive giving direct lifts from 1 to 3 cwt. and up to 5 cwt. on two part rope with the jib and a range of speeds from 45 ft. to 175 ft. per minute. The winch is supplied with 1½ h.p. Weatherproof Electric Motor Starters to suit 400/3/50 cycles A.C. or 110/3/50 A.C. Power Supply and alternatively various petrol prime movers.

Control is by means of a single weighted operating lever incorporating the re-set device for the overwind preventer and on release of the lever the hoist drum automatically returns to the stop or safety position. The radius of the jib can be adjusted for varying working clearances and the king post assembly is fitted with ball bearing races top and bottom providing for almost effortless slewing of maximum loads. *A.C.E. Machinery Ltd., Harlequin Avenue, Great West Road, Brentford.*

Senior Economisers

A well-illustrated and detailed book has been published by the above company. It deals with the three main types of their economisers, all of which have the characteristic straight gas passages. The construction of each type is described and the album of photographs and drawings gives the performance under test of some 50 installations. *Senior Economisers Ltd., 11, Southampton Row, London, W.C.1.*

Elliott Bros. and James Gordon & Co.

The Elliott-Hagan Control System for Steam Plants has been announced by the above companies.

The Elliott-Hagan System is available from both Companies, whose Sales and Technical Departments will be glad to assist the User, Consultant and Contractor with their joint experience. Their specialist staffs and manufacturing resources enable them to design, supply and commission complete installations for all types of steam plant.

Enquiries for complete systems should be addressed either to *Elliott Brothers (London) Ltd., Century Works, Lewisham, London, S.E.13,* or *James Gordon & Co., Ltd., Dalston Gardens, Stanmore, Middlesex.*

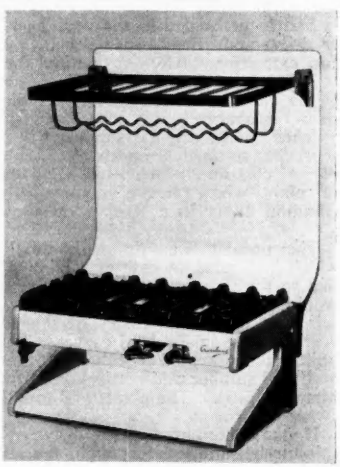
Crossland (Rugeley) Ltd.

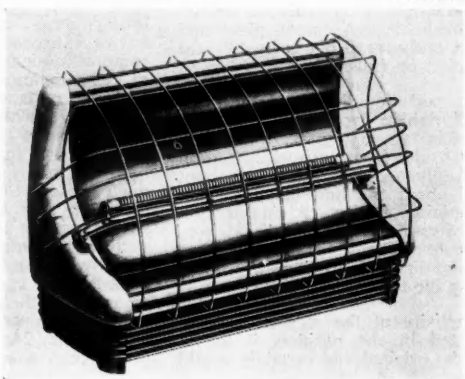
The Crossland 'Compact' Hotplate-Griller is a very welcome addition to the range of appliances suitable for small kitchens and has the very noteworthy feature of being available with a splash-back and plate rack.

It is a high quality production, well finished throughout with hard wearing vitreous enamel, the standard colours being cream with green sides and black grids.

As far as it is possible the appliance has been designed to avoid grease traps and the burners and grids may be lifted out for cleaning.

The dimensions are: Width 16½ in., depth 11 in., height 8 in. (with splash-back, height 22½ in.).

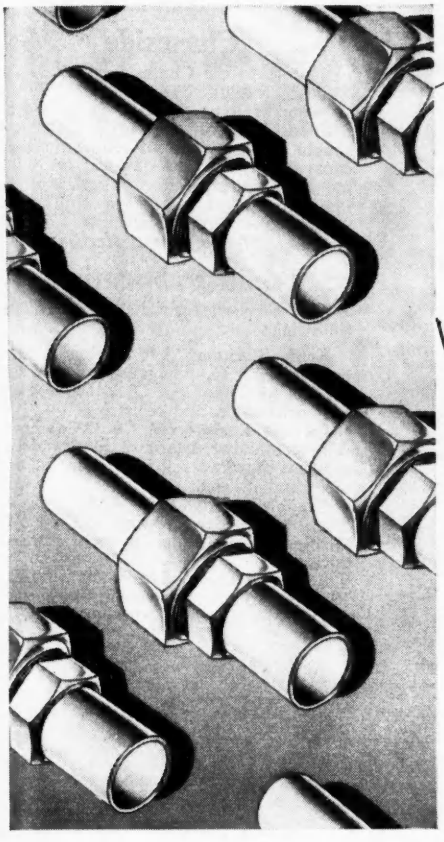




The 'New' portable gas fire model No. 8505 fitted with an effective approved pattern safety guard is an ineresting new production.

In appearance this fire is most attractive and its modern streamlined design with its rounded smooth surfaces does not permit the lodgement of dust and renders cleaning particularly easy. The highly polished reflector is efficient and radiates the heat from an unbreakable metal element over a wide area.

Crossland (Rugeley) Ltd.



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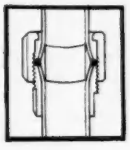

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